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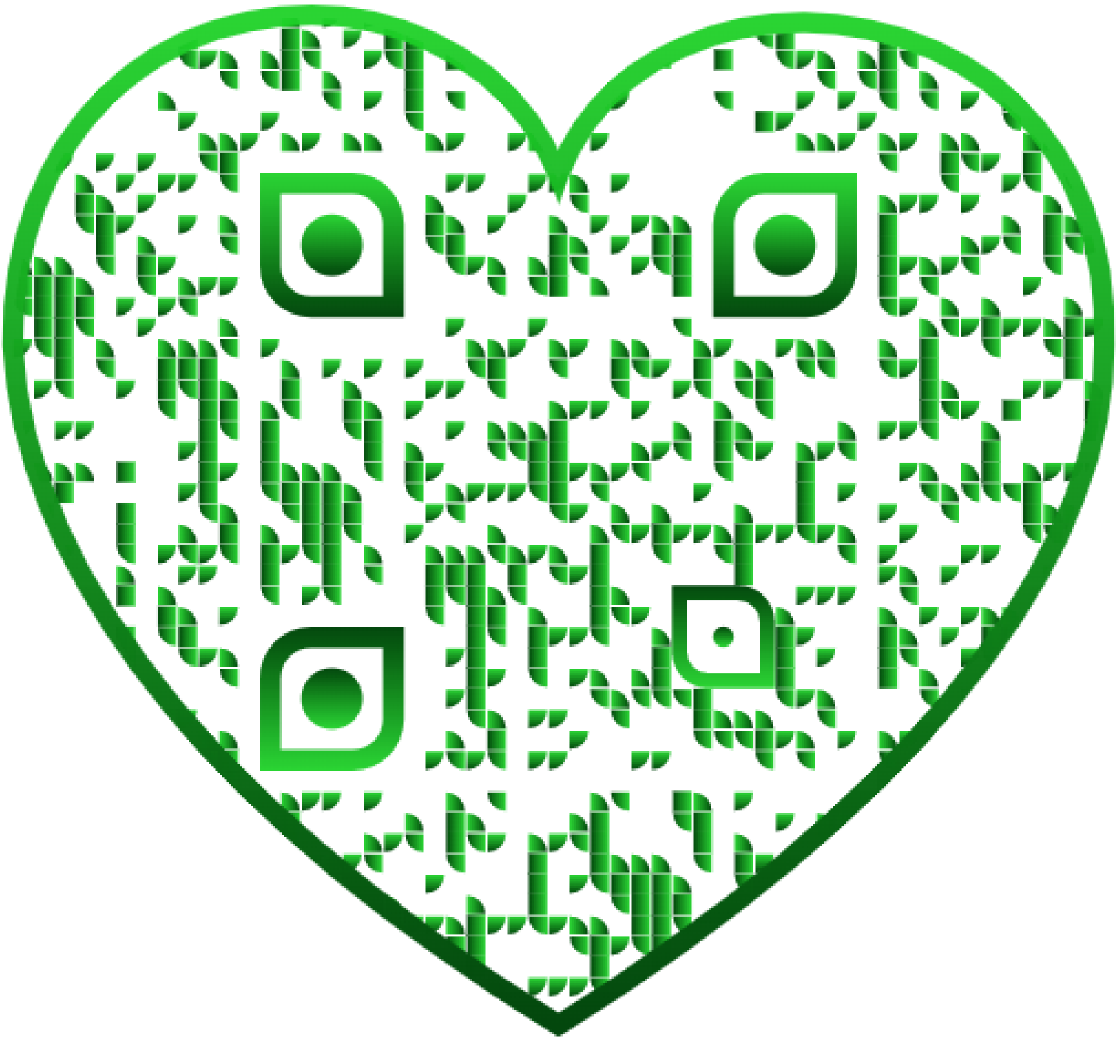
The secret wallabies on the Isle of Man

How I rewiggled a Scottish river

Protecting the world's tallest flying bird

ROARING BACK

New hope for Africa's most charismatic big cat



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ON THE BBC THIS MONTH

Chris Packham and Michaela Strachan

Springwatch

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A Spinosaurus takes its young on a journey

Walking With Dinosaurs

Stunning visual effects bring dinosaur stories to life in this groundbreaking series – from a Spinosaurus on a dangerous voyage to one of the largest dinosaur herds that ever lived – based on clues from dig sites around the world.
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Guardians

This six-part series, developed through the Royal Foundation's United for Wildlife programme, provides a rare on-the-ground look at the people helping to protect some of the world's most fragile ecosystems.
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Cecil's death brought lions' plight into focus

I'm making the most of these reasons to be cheerful

PAUL McGUINNESS, EDITOR

It's 10 years since the shooting of Cecil the lion by a trophy hunter caused shockwaves worldwide. And while the debate rages about whether hunting is good or bad for wildlife, Sara Evans' cover feature this issue (p48) examines the fate of Africa's lions in the decade since. Without giving too much away, there is cause for hope as lion numbers seem to be on the rise.

Nature is amazing at recovering – when we let it. But sometimes it needs our help, and not least to undo how we've tried to shape it. In the case of another of this month's features (p68), that is quite literally what Pete Cairns did with a Scottish burn. Rewiggling (my new favourite word) is basically putting the wiggle back into rivers that have been previously straightened, and so restoring the natural balance of things.

So I'm going to take heart from the positives while I can. Happy reading!

Paul

BBC wildlife

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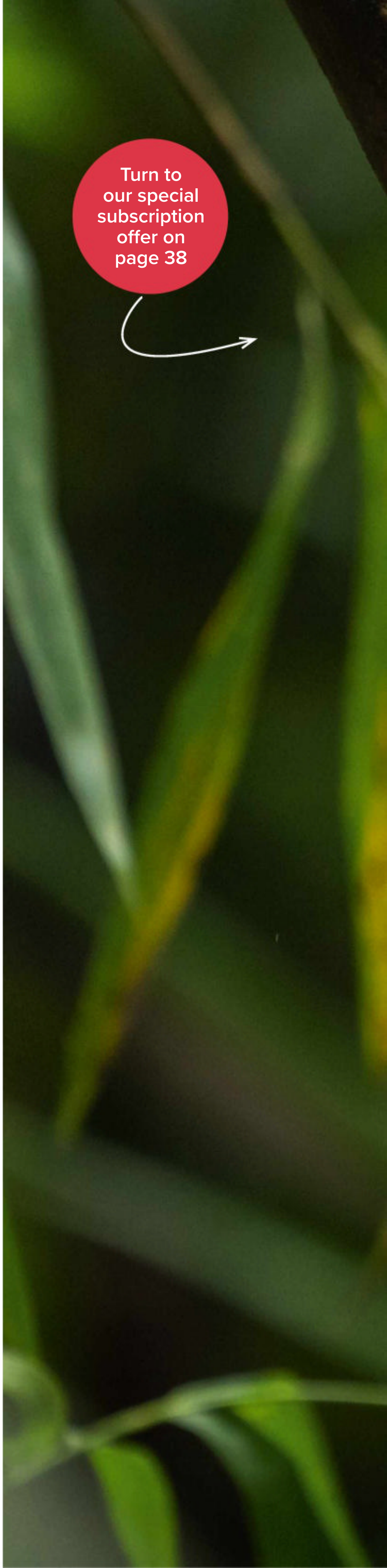

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MONKEY ON A TREE: HEIKKI PULKKINEN/GETTY

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BBC Wildlife No. 08 Vol. 43

BBC wildlife JULY

The secret wallabies on the Isle of Man

How I rewiggled a Scottish river

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ROARING BACK

New hope for Africa's most charismatic big cat

THE COVER

This splendid lion portrait was taken in Kgalagadi Transfrontier Park in South Africa. "It gave an enormously loud roar, to call on the female in the area," says photographer Etienne Outram. "The female came after a few minutes. This pose was while watching the female arrive."

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A new perspective on life in the undergrowth

LION: ETIENNE OUTRAM/ALAMY; DAISY: THEO BOSBOOM; CRANES: BERNARD CASTELEIN/NATUREPL.COM; FLYING FOX: JUERGEN FREUND/NATUREPL.COM; WASP: MATTHEW RICHARDS/PHOTOPLUS MAGAZINE/GETTY

Every month, only in *BBC Wildlife*

NICK BAKER
"Fringing the entire insect's body are even more tubercles, each armed with a barricade of stout hollow spines." *p36*

KATE BRADBURY
"Their leaves were the freshest spring green and their male flowers hung in luxurious dangling clusters." *p27*

MARK CARWARDINE
Unfortunately, we're unable to feature a column from Mark this month but he'll be back next issue.

LUCY COOKE
"Hyenas outperform other social animals in cooperative problem-solving tasks. They can even count." *p29*

MIKE DILGER
"Waiting in the wings is a huge array of marine predators, including sharks, dolphins, birds and whales." *p32*

DAVID LINDO
"Flocks of hundreds of thousands of birds create an amazing aerial spectacle – a tourist attraction in their own right" *p31*

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A decade after Cecil the lion was shot, there are encouraging signs of hope for lion numbers

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The huge benefits for wildlife of restoring rivers to more natural shapes

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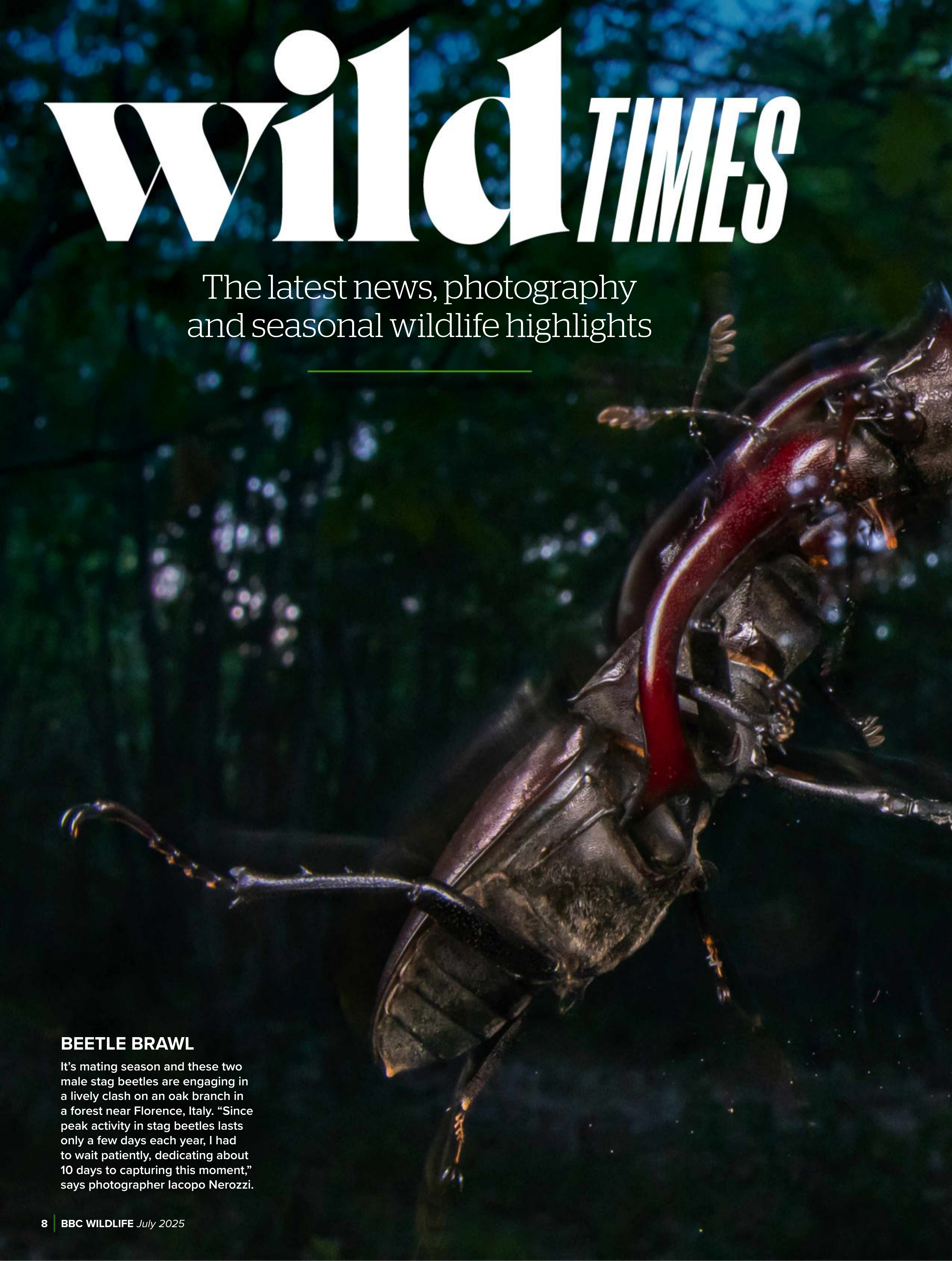
wild TIMES

The latest news, photography and seasonal wildlife highlights



BEETLE BRAWL

It's mating season and these two male stag beetles are engaging in a lively clash on an oak branch in a forest near Florence, Italy. "Since peak activity in stag beetles lasts only a few days each year, I had to wait patiently, dedicating about 10 days to capturing this moment," says photographer Iacopo Nerozzi.

BEETLES: IACOPO NEROZZI/ENVIRONMENTAL PHOTOGRAPHY AWARD

FLOWER POWER

It's no surprise to see these violet-capped woodnymph and Brazilian ruby hummingbirds feeding on flowers in the Atlantic Forest in Brazil. The tiny, brightly coloured birds have such high metabolisms that they must consume a colossal volume of nectar, eating every 10 minutes.

HUMMINGBIRDS: MAXIME ALIAGA/NATUREPL.COM

Elk could return to the UK after 3,000 years

The first stage of a new rewilding project plans to introduce elk to enclosures in the East Midlands

BRITAIN COULD BE GETTING A NEW ecosystem engineer: in the wake of the ongoing and now legal reintroductions of beavers into watersheds around the country, two Wildlife Trusts now want to bring back the elk. Also known as moose in North America, it is the world's largest species of deer. A bull can stand 2m high at the shoulder and weigh up to 700kg. The huge, palmate antlers make it instantly recognisable.

Elk are also native to the British Isles, though they went extinct, probably as a result of hunting and habitat loss and fragmentation, some 3,000 years ago. In Europe, they are found over large parts of Scandinavia and Russia, and are slowly recolonising areas as far west as the Poland-German border. Now, Derbyshire and Nottinghamshire Wildlife Trusts say they are investigating whether elk would be an appropriate species to release into two large fenced enclosures where they have previously reintroduced beavers.

According to Rachel Bennett, deputy director of wilder landscapes at Derbyshire Wildlife Trust, elk are unusual in being a semi-aquatic deer species "that moves through dynamic connected habitats in a unique way. They will be in water one day, a riparian floodplain the next and then a grassland."

Elk influence and modify wetland habitats through a variety of actions, including seed dispersal and bioturbation (churning up sediments in a lake or river and releasing nutrients). They also open up woodlands by feeding on vegetation, allowing other plants to flourish in the gaps.

Bennett says there is still a lot of research to be carried out. "We don't want to bring elk back only for them to go extinct again," she says. It will also be important to carry out extensive consultations with local communities.

The next stage would be to release some individuals into two fenced reserves – one near Derby and the other near Sheffield. A much longer-term plan, adds Bennett, would be assessing whether elk could ever be brought back into unfenced reserves.

"They could have benefits for society by helping to restore wetlands that would reduce flood risks and sequester carbon," says Bennett. **James Fair**

MOOSE BULL: DANNY GREEN/NATUREPL.COM

A bull elk's antlers can reach a span of up to 1.2m

The Chilean flamingo can live for up to 50 years

Flamingos create whirlpools to catch prey

By foot stomping and head jerking, flamingos create vortexes to catch food

FLAMINGOS MAKE SWIRLING 'TORNADOES' in the water to efficiently collect invertebrates, according to a new study published in *Proceedings of the National Academy of Sciences*. By analysing Chilean flamingos at Nashville Zoo, USA, lead author Víctor Ortega Jiménez discovered that "individuals created circular, concentric waves at the surface of the water".

Flamingos prey on small creatures such as brine shrimp, which move around in the water and tend not to be concentrated in a single place. The researchers observed the birds using their floppy, webbed feet to churn up mud, and jerking their heads up and down in the water like plungers, to create underwater tornadoes that suck prey animals into their mouths. Keeping their heads upside down and chattering their beaks, the birds also formed many small water funnels alongside this larger one to consume the concentrated prey.

Flamingos employ another method to create these tornadoes, known as skimming. Using their specially adapted beaks and S-shaped necks, they push their heads forward while clapping their beaks underwater to create a sheet-like vortex that also sucks in prey. **Beki Hooper**

FLAMINGOS: GABRIEL ROJO/NATUREPL.COM

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It was the naturalist Charles Darwin who put these paradise isles on the map, visiting in 1835 and noting the differences between subspecies on the various islands. This led him to develop his theory of evolution driven by natural selection, outlined in his seminal book On the Origin of Species. Today, the Galápagos Islands are sometimes likened to an open-air laboratory, attracting evolutionary biologists and wildlife lovers alike.

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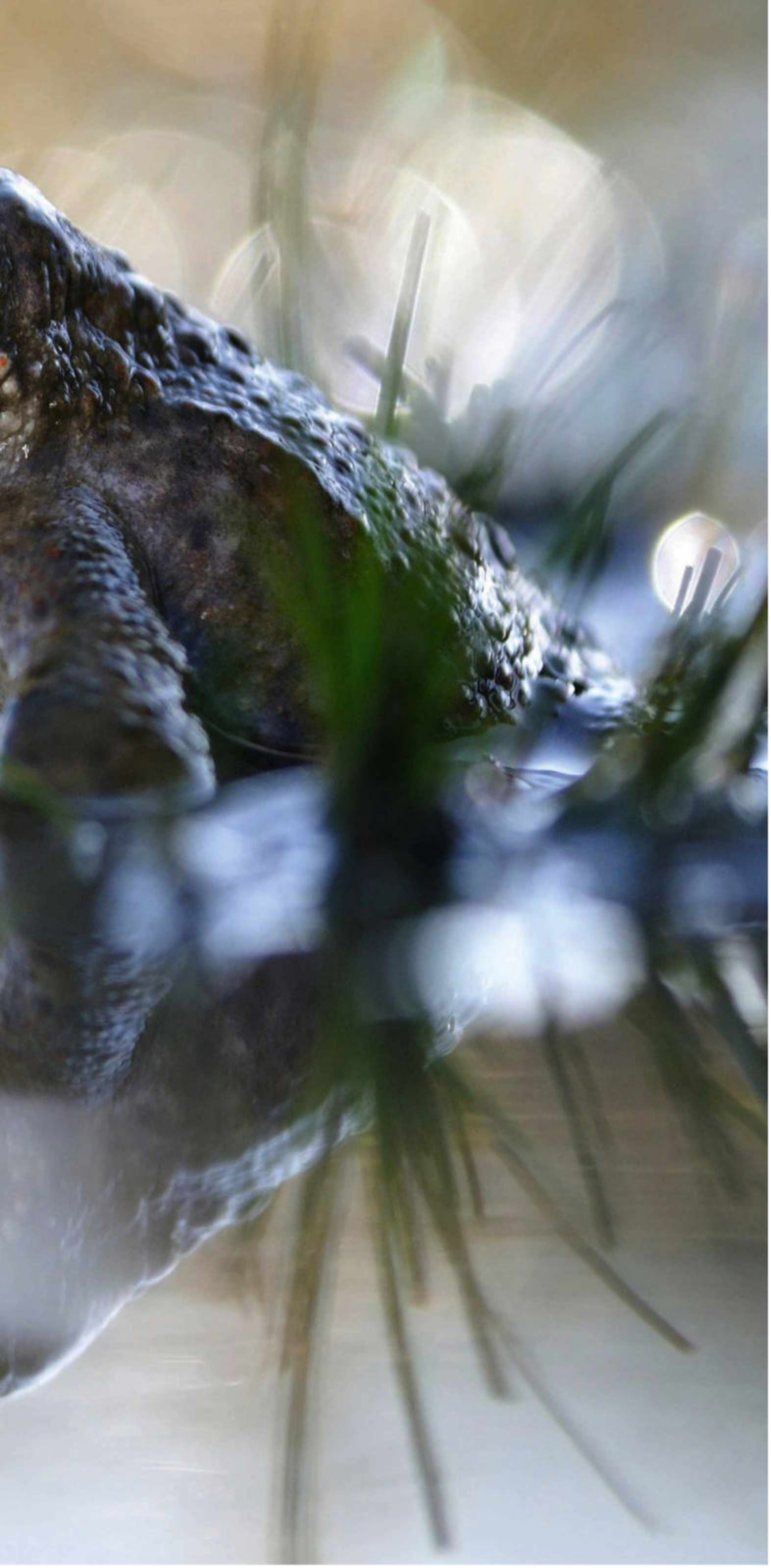
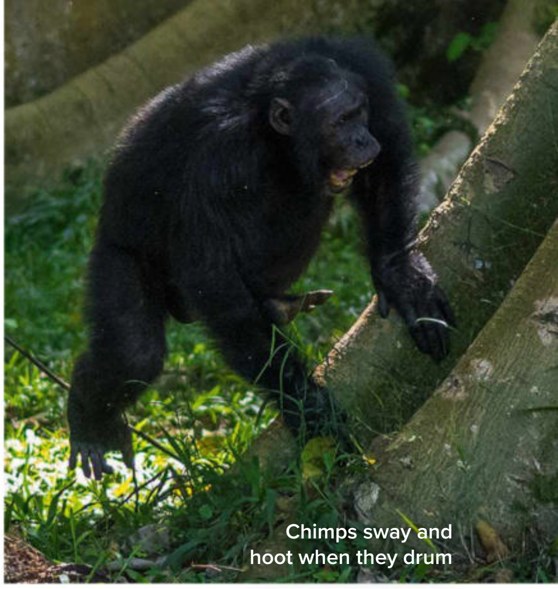
In the UK, the natterjack toad is threatened by habitat loss, which includes coastal sand dune systems and sandy heaths

NATTERJACK COMEBACK

Natterjack toads have bred at a site in the South Downs National Park for the first time in 50 years, producing a total of 28 toadlets. The breeding success of this now-rare amphibian is thanks to a reintroduction programme and habitat restoration, led by Amphibian and Reptile Conservation, that began in 2021.





Chimps sway and hoot when they drum

Chimpanzee rhythms

Chimps can drum in similar way to humans

Wild chimpanzees can drum rhythmically, sharing some characteristics of human music, a new study has found. Chimps across Africa beat huge tree roots as a form of communication and a way to express dominance.

"The boom of each hit is so powerful that it can carry for over a kilometre," says Catherine Hobaiter, a primatologist at the University of St Andrews, "and they sometimes even leap from one large root to another. Their tempo is so fast they move almost in a blur."

The study – a partnership between the University of St Andrews, the University of Vienna and the Sapienza University of Rome – built on a previous study that showed every chimpanzee has their own unique drumming style, and that drumming helps keep others in their group updated about their location and what they're up to. The latest findings, published in *Current Biology*, show that drumming styles also have geographic variations. "Chimps from East Africa like to alternate short and long hit intervals, while chimps from West Africa like to drum with more regularly spaced hits," says Vesta Eleuteri, a PhD candidate at the University of Vienna. This suggests that chimps learn from or are influenced by their fellow chimp drummers in the local music 'scene'.

"We were excited to find not only the evidence that wild chimpanzees have rhythmic structure in their drumming but that, like us, they use different rhythms," says Hobaiter. "The building blocks for using basic rhythm in our social behaviour were likely around long before humans arrived."

Graeme Green

TOAD: TIERFOTOAGENTUR/ALAMY; CHIMPANZEE: ADRIAN SOLDATI

A few wallabies are thought to have escaped an Isle of Man zoo in the 1960s. The animals have lived on the island since

The wallaby controversy

Feral wallaby populations are growing on the Isle of Man – and native wildlife is suffering

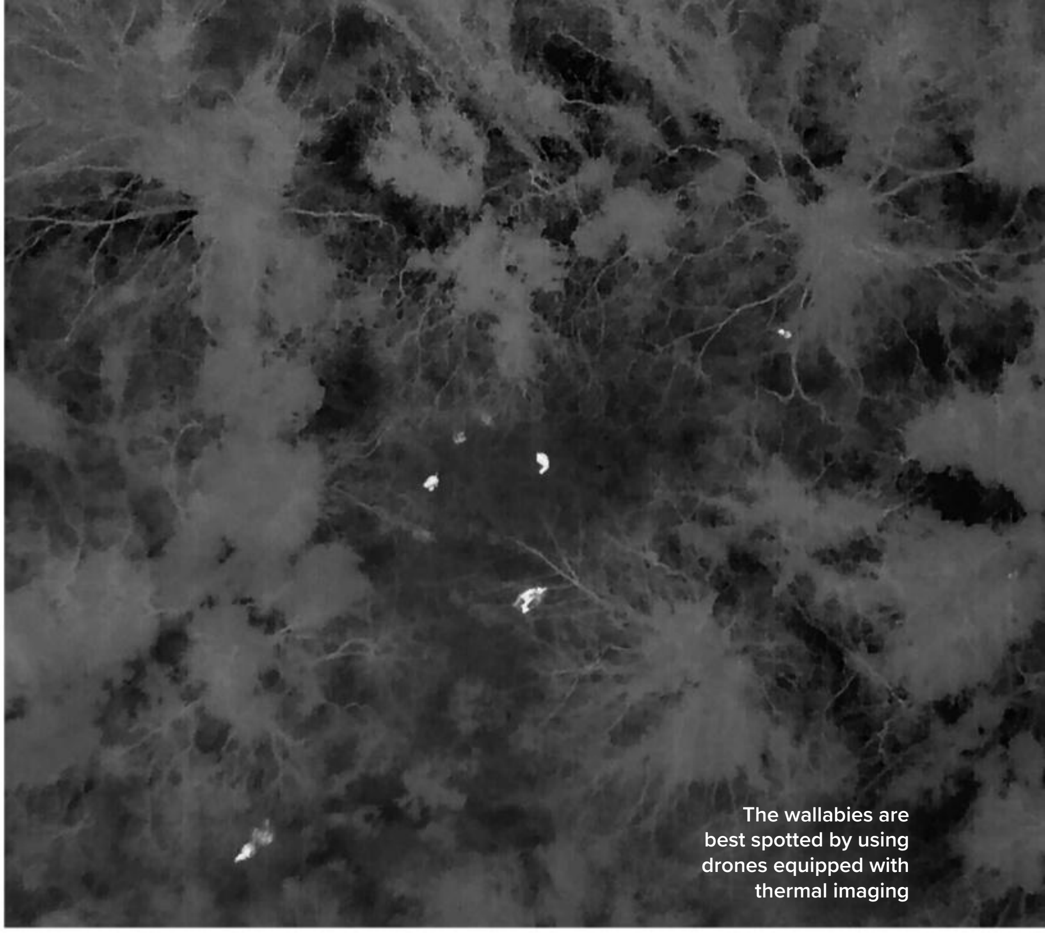
It's 9pm in late April in an area of the Isle of Man known as the Ballaugh Curragh, and a most unusual nocturnal migration is taking place. As darkness descends on a 2km² area of wet woodland, an estimated 600 red-necked wallabies are emerging to feed on the surrounding grasslands.

You'd think that 600 wallabies would be easy to spot as they awake from their daytime slumbers, especially since the island has no large native land mammals to confuse them with. But as the Manx Wildlife Trust's head of conservation David Bellamy points out, they blend in well with the tangled, swampy forest of grey willows.

> "Instead of dozens of wallabies as had been believed, 870 individuals were counted in the north alone"

"The fact that four of us, who are looking for wallabies, just walked past one without seeing it and it's only 15m away highlights how easy it is to be here and not realise you are surrounded by them," he says. (It's only spotted with a thermal-imaging camera.)

It surely goes without saying that the wallabies should not be on the Isle of Man,



The wallabies are best spotted by using drones equipped with thermal imaging

“Something has to be done but no one wants to use the word ‘cull’”

and especially not in the Ballaugh Curragh, the island’s only Ramsar site and area of special scientific interest. The macropods are native to mainland Australia and Tasmania, but they were brought to the government-owned wildlife zoo in 1965.

Shortly afterwards, it seems, a few wallabies escaped (no one knows how many but it was probably fewer than 10), and they’ve been living as a feral population ever since. Until a couple of years ago, it was assumed the total population was fewer than 100 animals. But in 2023 and 2024, two surveys using drones enabled with thermal-imaging cameras blew this assumption far out into the windy Irish Sea.

Instead of dozens of wallabies as had been believed, a staggering 870 individuals were counted in the north of the island alone, and it’s now believed there are somewhere between 950 and 1,150 animals living wild. Because they are all descended from a handful of individuals, they are almost certainly inbred, with some individuals suffering from afflictions that leave them with milky white eyes and probably blind. These same animals are described as appearing disorientated.

ARGUABLY MORE URGENT ARE THE impacts the wallabies are having on the Isle of Man’s native wildlife, and farmers’ fears they could spread diseases to their livestock. Everyone agrees that something has to be done but no one wants to use the word ‘cull’, not least because the wallabies have become embedded within Manx national identity and are a tourist attraction, too.

“They divide opinion,” says Philip Jenkins, who runs a tourist accommodation business on the island. “We always tell our guests to go and see the wallabies, but I wouldn’t say they bring people to the island. It’s a government location they escaped from, and it needs to do a proper study and work out what the best course of action is.”

Leigh Morris, who was the Manx Wildlife Trust chief executive until May, says the drone survey is changing the way islanders see this species, which until now had been viewed as harmless. “I had a very pro-wallaby person in my office, and they were saying there weren’t that many of them and asking why we were stirring this issue up,” he says. “So I showed them the drone footage and they said, ‘There’s 62 in one field!’”

The trust is now starting to ask itself some hard questions about just what

BRITAIN’S WILD WALLABIES

- There are an estimated 50–60 red-necked wallabies on Inchconnachan island in Loch Lomond. They were introduced in the mid-20th century by the then-Countess of Arran.
- Five red-necked wallabies were released from a private collection and colonised the Roaches in the Peak District during World War II. At their peak, there were said to be 50 animals, but the last confirmed sighting was in 2009.
- In 2020, a study mapped 95 wallaby sightings across Britain over a 10-year period, with the Chilterns a particular hotspot, but there were no confirmed breeding populations.

WALLABY IN MEADOW: DAVID CHAPMAN/ALAMY; DRONE IMAGE: BH WILDLIFE CONSULTANCY/MANX WILDLIFE TRUST

The wallabies ended a winter hen harrier roost on the island

Curlews are also under threat

“As well as the wildlife perspective, there’s the risk to livestock, domestic animals and human health”

impact the incomers are having. Certainly, in the Ballaugh Curragh, where they are most densely concentrated, there have been some devastating losses.

It used to be home to a huge winter hen harrier roost, for example, which at its peak hosted 160 birds, the largest in Europe – but they have completely disappeared. (There are still nearly 40 breeding pairs every year, a number that has remained broadly static in recent years.) Corncrakes have also gone and curlews are only just holding on.

These are three very different species but they have one thing in common – they are ground-nesting and ground-roosting, and so especially vulnerable to disturbance. “I think a hen harrier roost and a large wallaby population are incompatible,” says Bellamy. “The hen harriers want zero disturbance, and the wallabies are quite clumsy animals, crashing around and making a lot of noise.”

The Isle of Man government is more concerned about whether the wallabies have the potential to spread disease to livestock. “The issue of the wallabies has come up in a number of different areas,” says the environment minister Clare Barber. “There’s the wildlife perspective and our Biosphere status, but we also want to look at the biosecurity risks and the risk to livestock, domestic animals and human health.”

With this in mind, Dr Arno Wuenschmann, a professor of veterinary pathology from the University of Minnesota, was asked to carry out postmortems on three wallabies. (Wuenschmann became involved partly because of his expertise, but also because he is a frequent visitor to the Isle of Man himself.)

The most eye-catching of Wuenschmann’s findings was of the toxoplasmosis parasite in the brain and eye of one of the wallabies. Toxoplasmosis is a common wildlife disease in Europe and is also carried by domestic cats, who act as an intermediate host.

An estimated 10–30 per cent of the UK population has been infected with this pathogen at some point in their lives, but it has no impact on most healthy people, with the exception of pregnant women, where it can cause miscarriages, stillbirths and congenital defects in offspring.

But toxoplasmosis is not native to Australia, and wallabies have not evolved to live with it, so they may be affected to a much greater degree. “They will have a susceptibility to toxoplasmosis that native wildlife doesn’t,” says Wuenschmann. “It’s not a surprise we found it but it may explain some of the neurological signs that have been reported.”

Wuenschmann also found evidence of a gastric worm that is only found in wallabies and kangaroos, and which you would expect to see. It’s possible, he says, they are impacted by some combination of their lack of genetic variability, toxoplasmosis and the gastric worm, but to be really certain of what’s going on, he says, they need to examine more animals.

“It’s for somebody else to decide what you want to do about it, if anything,” Wuenschmann adds.

Leigh Morris is aware that the public, and the trust’s members, might not take kindly to the idea of managing the number of wallabies. “Disappointingly, we had a few people criticise us for killing ‘long-tails’ (what Manx people call brown rats) to protect the shearwater population,” he says.

Bellamy says a national conversation needs to take place and, though the wallabies’ impact on native wildlife is clearly negative, he acknowledges there will be no appetite for eradicating them entirely. “I do think one day we will accept that, for the welfare of the animals themselves, for farmers, for road safety and for ecological reasons, we should bring the population down to a manageable number,” he says.

“We might say we don’t want them in the south of the island and we don’t want them in the hills – the Ballaugh Curragh may be okay for some, but we need a level of containment.”

Elsewhere in Britain, multiple species are culled for ecological reasons – rats on islands to safeguard seabirds, American mink to protect water voles, and both native and non-native deer for the good of our woodlands – but the Isle of Man has not had to make such hard decisions. It does now.

ABOUT THE AUTHOR

James Fair is a wildlife journalist with a specialism in conservation and controversial issues. Read more at jamesfairwildlife.co.uk.

HEN HARRIER: JAMES LEONARD/ALAMY; EURASIAN CURLEW: SHARON PAINTER/ALAMY

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7 nature encounters for the month ahead

WITH NATURALIST AND AUTHOR BEN HOARE

1

Little owls, such as this juvenile, can be seen in the daylight, often perching on a branch, rock or telegraph pole

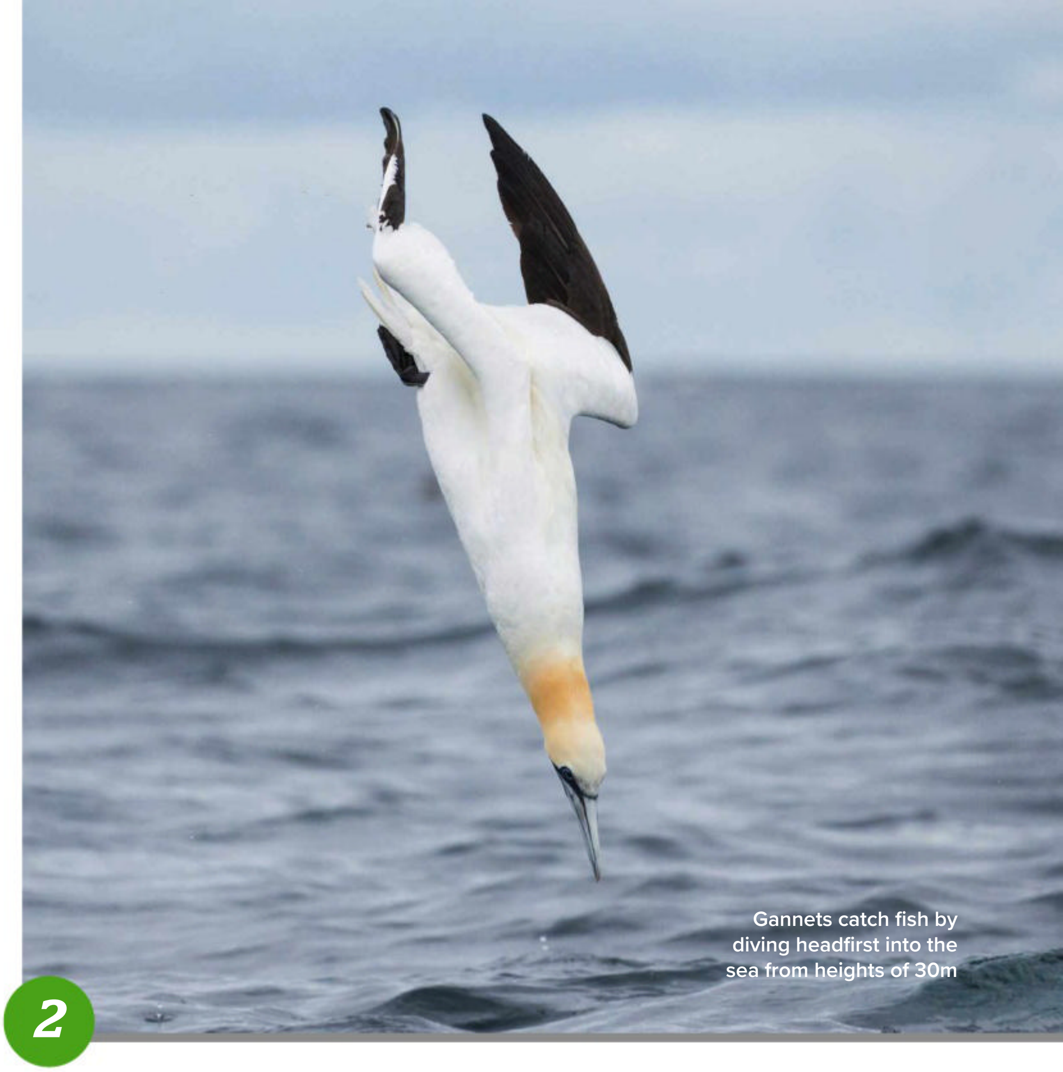
Small beginnings

At the height of summer, little owls are often active during daylight in the morning and evening. In July the recently fledged young start to explore the area around the nest. The owlets are adorable, with outsize eyes and fluffy feathers. Still dependent on their parents, they beg for beetles, worms and other tasty titbits with a ‘seep seep’ call whose piercing persistence anyone caring for little humans will surely recognise.

Taking the plunge

Northern gannets diving into the sea at speeds of up to 100kph to catch fish are a summer spectacle like no other. In his beautifully written book *The Lost Spells*, Robert Macfarlane captures the transformation that occurs as these amazing birds fold their wings and tuck their feet away moments before impact: they become "a perfect paper aeroplane; all angles, creases, points". During their dives, the gannets experience greater G-forces than astronauts, protected by a suite of adaptations including airbag-like sacs in the head and chest. When a flock attacks a shoal of herring or sardines en masse, the simultaneous splashes make it look as if the sea is being strafed by machine-gun fire.

Gannets roll to one side as they enter a dive, which is thought to give them a clear line of sight so they can stay locked on to their target. Recent research found that individual gannets consistently roll left or right – the first time left or right-handedness has been seen in diving seabirds.

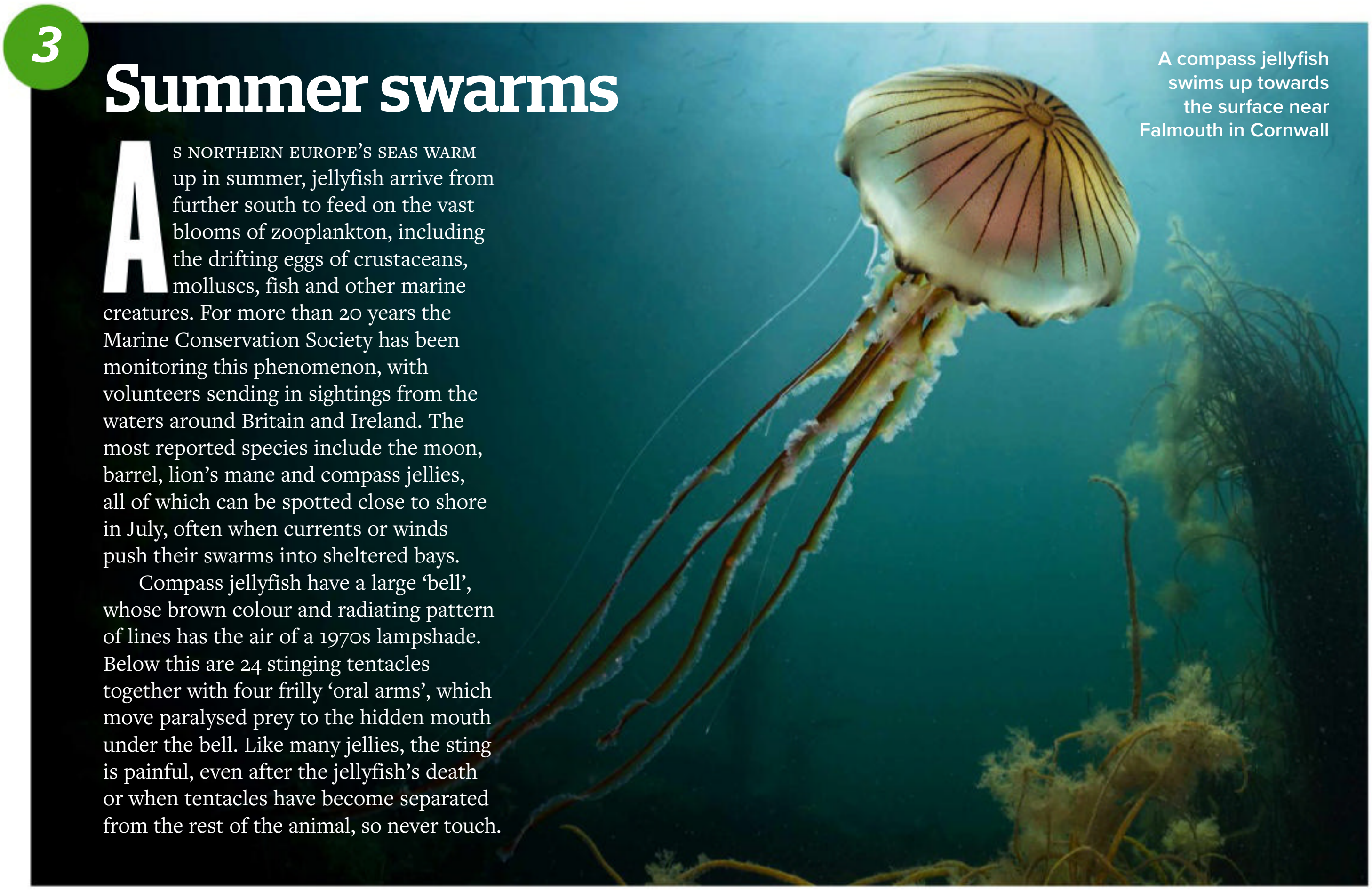


Gannets catch fish by diving headfirst into the sea from heights of 30m

2

3

Summer swarms

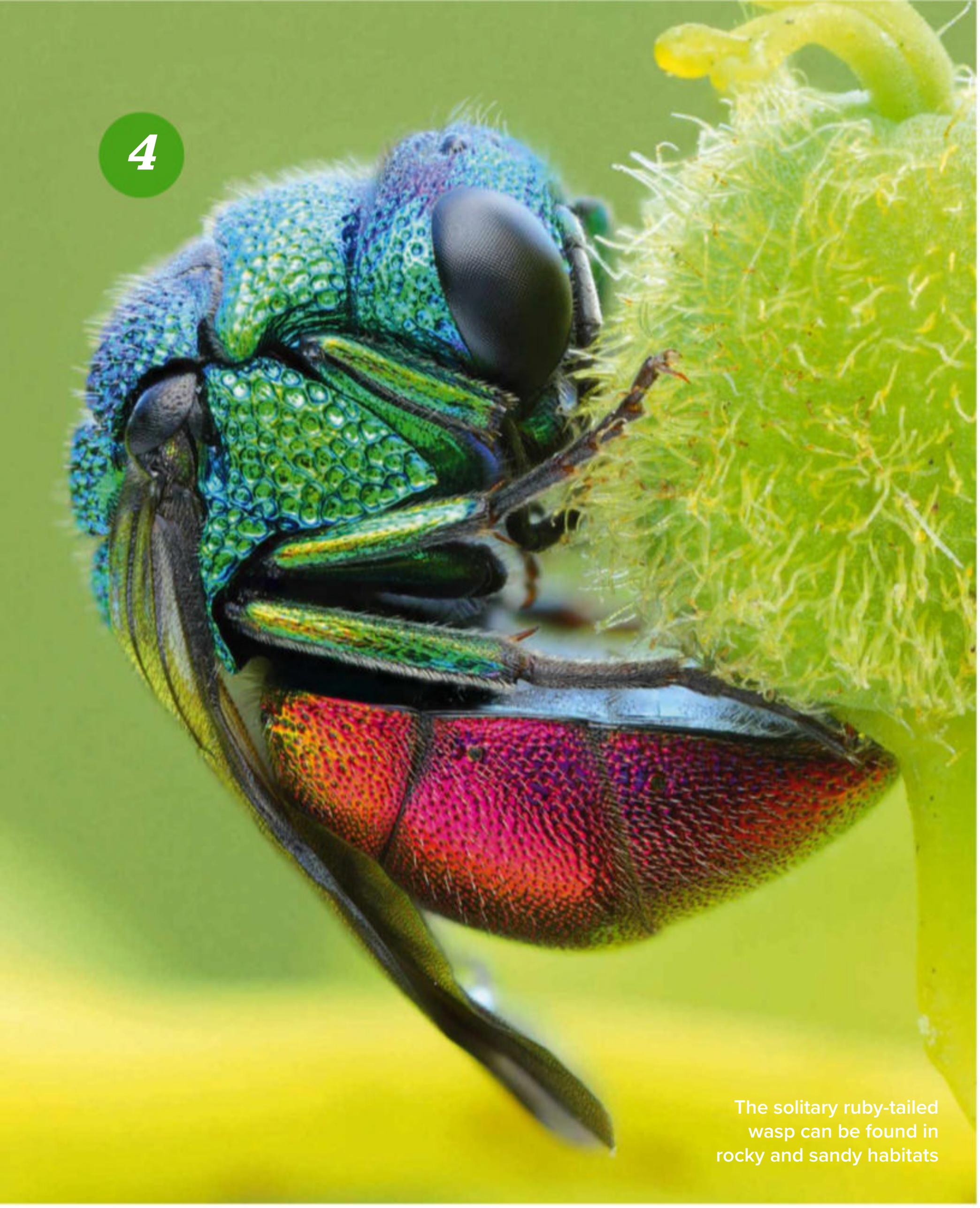


A compass jellyfish swims up towards the surface near Falmouth in Cornwall

As northern Europe's seas warm up in summer, jellyfish arrive from further south to feed on the vast blooms of zooplankton, including the drifting eggs of crustaceans, molluscs, fish and other marine creatures. For more than 20 years the Marine Conservation Society has been monitoring this phenomenon, with volunteers sending in sightings from the waters around Britain and Ireland. The most reported species include the moon, barrel, lion's mane and compass jellies, all of which can be spotted close to shore in July, often when currents or winds push their swarms into sheltered bays.

Compass jellyfish have a large 'bell', whose brown colour and radiating pattern of lines has the air of a 1970s lampshade. Below this are 24 stinging tentacles together with four frilly 'oral arms', which move paralysed prey to the hidden mouth under the bell. Like many jellies, the sting is painful, even after the jellyfish's death or when tentacles have become separated from the rest of the animal, so never touch.

OWL: OSCAR DEWHURST/NATUREPL.COM; GANNET: GUY EDWARDES/NATUREPL.COM; COMPASS JELLYFISH: LEWIS JEFFERIES/NATUREPL.COM



The solitary ruby-tailed wasp can be found in rocky and sandy habitats

Glittering gem

TINY BUT SPECTACULAR, THE RUBY-TAILED wasp is one of Europe's most stunning insects. Hardly longer than a grain of rice, it shimmers all over with fabulous metallic colour – green and blue on the head and thorax, red and bronze on the abdomen. It's so unlike the stripy, yellow-and-black creatures that gatecrash summer picnics and barbecues, you might not even realise it's a wasp.

In fact, the way the wasp looks is not the only thing that sets it apart. It is actually a cuckoo – the female sneaks into the nests of mason bees to lay her eggs, which hatch into parasitic grubs that devour the host's eggs and larvae.

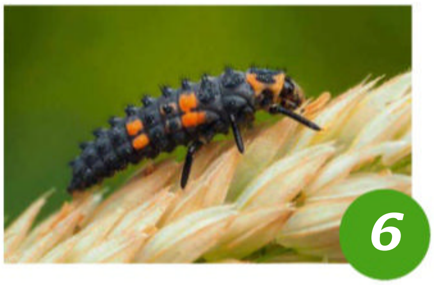
Mason bee emerging from a bee hotel nest

ABOUT THE AUTHOR

Ben Hoare is a wildlife writer, editor and all-round nature nerd. He also writes highly acclaimed illustrated natural history books for children.

Boxing clever

Tree sparrows are far less common in farmland than they were, but readily use the nestboxes provided on some farms and nature reserves, which at least makes their population easy to survey. They like company, nesting in colonies of up to a dozen or so pairs.



Park predator

In June and July look out for the larvae of seven-spot ladybirds, among the most ferocious predators in gardens and parks. These aphid-suckers have black and orange bodies covered in spikes, giving them a somewhat reptilian appearance, almost like miniature crocodiles.

Wallflower

The showy red flower you might have seen rambling over cliffs, railway embankments and castle ruins in summer is probably red valerian. Not native but now familiar over much of Britain and Ireland, this plant thrives in dry, rocky places. Its nectar attracts hummingbird hawkmoths.

WASP: MATTHEW RICHARDS/PHOTOPLUS MAGAZINE/GETTY; MASON BEE: PHIL SAVOIE/NATUREPL.COM; SPARROW: LEE HUDSON/ALAMY; LADYBIRD LARVA: LARRY DOHERTY/ALAMY; RED VALERIAN: HOLGER BURMEISTER/ALAMY

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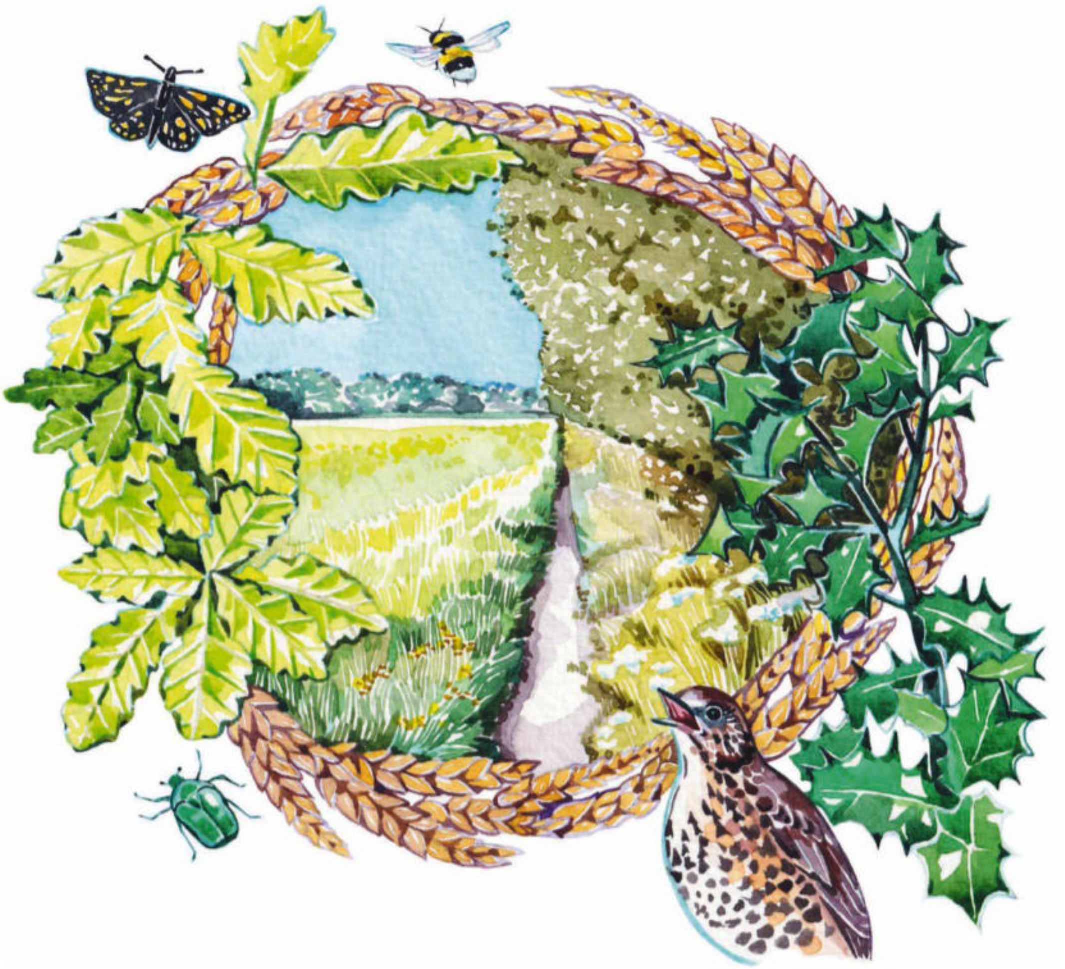

NOTES ON NATURE

KATE BRADBURY

> “In folklore, the Oak King and Holly King battle on each solstice”

“BACK IN MAY, AFTER WINTER AND the slow creep of early spring, I took myself along a disused railway line near Lewes, Sussex, to be consumed by the month’s riot. This barely used path was somewhat overgrown – nettles and cow parsley brushed my legs, while fresh growth in the canopy stole the bluest sky. Birds shouted from every branch, butterflies spilled from every flower. There were scurrying beetles, hungry nestlings and rustles of larger things in the undergrowth. There were nibbled leaves, mining bees and pollen-loaded bumblebees. The first cuckoo. Clouds of flies hanging languidly on the sticky air. It was too warm for the time of year, of course, but it felt magical. For a moment, surrounded by all this life, I felt abundance.

Standing tall over this spring riot was a line of mature oak trees. Their leaves were the freshest spring green and their male flowers hung in luxurious dangling clusters. What abundance have these trees known over the years that they miss now, I wondered. Who have they nourished and provided homes for, that have reciprocated in a myriad of ways? An oak tree can support some 2,300 species, from insects to birds, bats and other mammals that feast on its acorns in autumn. How does my spring baseline, with all its apparent loudening, compare to theirs?

The oak is steeped in folklore. Many ancient cultures revered it as a symbol of growth and plenty, with summer personified by the Oak King, dressed in green and crowned with oak leaves and acorns, with a face of sprouting oak leaves. The Oak King is a figure of fertility, of the swell of spring and waxing of the sun, as told through the pagan festivals of Imbolc, Ostara, Beltane and Litha. By contrast, the Holly King represents the waning sun and the shrinking of growth after the summer solstice, marked by the festivals Lughnasa, Mabon, Samhain and Yule. The Holly King is the ruler of winter and is clothed in red, with a crown of holly leaves and berries.

Nobody notices holly in spring – there’s too much else going on. There will have been some on my walk on that sunny May day, but I didn’t notice it. An evergreen species, the holly’s glossy foliage is drowned out by the new growth of its deciduous cousins, its inconspicuous green-white flowers blooming only from the sidelines.

The red berries, when they come, have their big moment in winter, standing out among the skeletons of neighbouring leafless branches. So valuable is the holly berry that entire fruiting trees are fiercely protected by mistle thrushes, who defend this precious food source from rival birds all winter. They do such a good job that the berries sometimes remain into spring.

In folklore, the Oak King and Holly King battle on each solstice, with the Holly King reigning from Litha (the summer solstice) and the Oak King taking over at Yule (the winter solstice). Some traditions place the rising power of these two giants at the equinoxes, but it’s the solstices that mark the changing of the guard.

Do they still? Climate change is blurring the boundaries, and it seems that the Oak King and Holly King are in battle for longer. As we approach Litha, the riot of spring reaches a crescendo. Life tips from new growth and nestlings to the development of winter fuel (fruit, seeds and berries) and fledglings. Thoughts turn to southerly migrations and the days become shorter.

But nature is no longer transitioning in the usual way. After Litha, the Holly King still waits to take his crown. We need to work out how we help him, how we restore balance to the seasons.

Kate is a wildlife gardening expert and author. Her latest book is *One Garden Against the World* (Bloomsbury).

ILLUSTRATION BY HOLLY EXLEY

ADVERTISEMENT FEATURE

The endemic Sri Lankan leopard

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WILD SRI LANKA

Think of safari and Africa probably springs to mind. But Sri Lanka, an island nation located in the Indian Ocean, also offers incredible opportunities for wildlife sightings and birdwatching. This beautiful country is home to breathtaking landscapes and a huge variety of animals, including the largest population of Asian elephants on Earth. Plus, palm-lined beaches and year-round warm weather make it a dream holiday destination.

Sri Lanka grey hornbill

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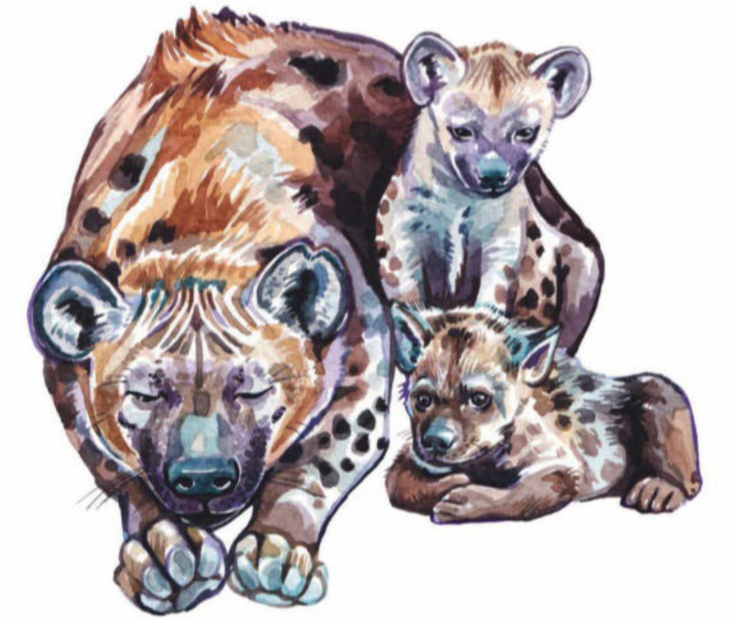
FEMALE OF THE SPECIES

SPOTTED HYENA

A carnivore with an underbelly that defies description



He, she or they, never underestimate a hyena. They've outsmarted us for millions of years, and their nether regions will blow your mind

This is my final column and I've loved introducing you to the extraordinary diversity of the female experience. But I have saved the most badass till last: the spotted hyena (*Crocuta crocuta*).

Few animals have been more misunderstood than the hyena – historically described as a cowardly, grave-robbing brute, of indeterminable sexuality. According to Pliny the Elder, the Roman author of the world's first animal encyclopedia, the hyena is "male during one year, and a female the next".

Pliny's sexual mythologising is a result of the female hyena's unconventional genitalia – a near-perfect facsimile of the male's. The *Crocuta*'s clitoris extends 17cm and is shaped and positioned exactly like a penis. She even gets erections, which form an integral part of her greeting displays. Females also sport a false scrotum, where the labia have fused and filled with fatty tissue. One anatomist declared males and females so similar that sex could only be determined by "palpation of the scrotum" – a rather foolhardy practice on an animal famous for its bone-crunching bite. I'd rather hazard a guess.

With no external vaginal opening, female hyenas must urinate, copulate and give birth through their multi-tasking 'pseudo-penis'. None of this is easy. Sex requires the male to penetrate a flaccid clitoris – a bit like trying to have sex with a sock. Birth is even more treacherous, like squeezing a cantaloupe melon out of a hosepipe. Fatalities, involving cub or mum, are not uncommon.

It is easy to see how the sight of a 'male' hyena giving birth through his penis led to the hermaphrodite myth. But it's less clear why the hyena's pudendum would take such a peculiar evolutionary path. We do know that spotted hyenas are highly intelligent animals, living in complex clan structures where females rule the roost. Their social system is matriarchal and extremely cooperative, with females working together to hunt and raise their young. But they are not just scavengers. They are exceptional predators, too, responsible for hunting 95 per cent of their food. They use teamwork, patience and intelligence to bring down prey much larger than themselves – such as water buffalo – by working in unison. Studies have even shown that lions scavenge more kills from hyenas than vice-versa.

Hyenas outperform other social animals, including chimpanzees, in cooperative problem-solving tasks. They can even count. Their intelligence allows them to outwit and outmanoeuvre rivals, and they use their superior communication skills to coordinate group activities, from hunting to defending territory. But perhaps the most fascinating – and often overlooked – aspect of the hyena is its relationship with humans. Early hominins shared the African savannah with hyenas, and it's likely that our lumbering bipedal ancestors were at constant risk of being preyed upon by these clever carnivores.

Our ancestors had only very basic stone tools and were probably scavenging more than hunting. They would not have been able to fight off a pack of hungry hyenas to protect their prize meal. This is a theory borne out by animal bones from the period that show cut marks from early stone tools mixed with the tooth marks of hyenas, suggesting that hyenas were laughing at us *and* stealing our dinner for as much as 2.5 million years. No wonder we don't like them.

I hope my columns have helped you appreciate females beyond their stereotype. I'm taking leave to finish my book about the diversity of male animals, who also need rescuing from limiting toxic labels.

Lucy Cooke is a broadcaster, zoologist and author of *Bitch: What Does It Mean To Be Female?* The Penguin paperback is on sale now.

BBC SOUNDS

Catch up with Lucy's three-part BBC Radio Four series, *Political Animals*

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WILD IN THE CITY

— WITH DAVID LINDO —

Millions of starlings descend upon Rome every year, creating spectacular murmurations – and a mess

St Peter's Basilica in Rome, long considered the largest church in the world, is a magnet for massive starling murmurations

The starling, AKA the common starling or, in the USA, the European starling, is a familiar bird. But you never see one hanging out by itself – they're always out and about in flocks, swarming over lawns or on rooftop aerials. Even during the breeding season, flocks of brown youngsters, so different to the smart spangled adults, form crèche flocks, learning all about being a starling.

Starlings were one of the first birds that I noticed as a fledgling birder. At the tender age of five, and without a field guide, let alone a pair of binoculars, I recognised them in my north London back garden. Back then I named birds as I saw them, so starlings were christened 'mummy birds', while blackbirds I deemed to be 'daddy birds'.

I was lucky to witness the dying days of those grand inner-London murmurations, whose numbers allegedly peaked at more than 100,000 birds. The flocks weren't called murmurations then. Despite being a word originating from the late 15th century, it has only come to be used as a collective noun fairly recently. Those incredible roosts in London suddenly collapsed to practically zero birds in the 1980s, reflecting the start of the decline of this species in Britain. Now, would-be starling-gazers in the UK have to journey far and wide to find a sizeable roost.

And so to Rome. Flocks of hundreds of thousands of birds create an amazing aerial spectacle there – a tourist attraction of the Eternal City in their own right. But where do they all come from?

An influx of migrants involving many millions of birds comes in from northern Europe and further east to spend the winter in the rest of Europe, including Britain. There are thought to be a total of 5–10 million birds that descend upon Rome between October and February, when they return to their breeding grounds (in 2025 visitors can combine seeing the starlings with the Vatican Jubilee celebrations). Starlings have roosted in the Italian capital since Roman times, but it was only in the 1920s that the large numbers that we know today started to form.

The birds are attracted to cities to roost because they are warmer than the countryside and offer more protection from predators – literally safety in numbers. Their grand murmurations are thought to be a signal for smaller flocks to join the main flock to roost. But when nightly performances are over and they settle down, things become less pretty. Thousands pack into the trees, bending the branches under their weight. And they poo incessantly – a kind of 'poo rain'.

As a result of an olive-rich diet (the fruits are consumed during the day when birds visit the surrounding countryside), droppings are sticky and oily, causing the surfaces they fall upon to be slippery. Cars and buildings are also coated, with corrosive results. It is said that 10 million birds produce 7 tonnes of guano – nightly.

To combat this, men in white biohazard suits and face protection masks, nicknamed 'starling busters', rock up under the roosting trees armed with megaphones blasting out the alarm calls of the starlings amplified 100 times. The birds panic and fly off en masse to find somewhere else to settle down. Recently, officials have also started turning up to shine laser lights into the assembled avian crowd, while falconers have been sending in falcons to scatter the flocks. So, when in Rome, do what the Romans do: enjoy the murmurations but don't stand under the trees!

David Lindo, AKA the Urban Birder, is a naturalist, broadcaster and author of many books, including *Fly: A Child's Guide to Birds* (Magic Cat Publishing)

DAVID LINDO: ASHLEY BOONE; STARLINGS: SAVERIO MARIA GALLOTTI/ALAMY

Mike Dilger’s

WILDLIFE SPECTACLES

The broadcaster, naturalist and tour guide shares the most breathtaking seasonal events in the world

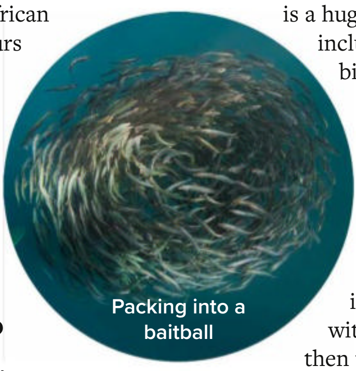
BEYOND THE SEA

SARDINE RUN

Each year, a vast shoal of sardines travels up South Africa’s Cape coast, creating a giant feeding frenzy

SOUTH AFRICA’S SARDINE RUN MIGHT just be the greatest wildlife spectacle you’ve never heard of. So large is this annual fishy movement that in biomass terms alone it has been estimated to rival the epic wildebeest migration across the East African plains. But, as it mostly occurs underwater, it only receives a fraction of the publicity.

South African sardines, also known as Pacific pilchards, are small, silver, torpedo-shaped members of the herring family, which reach up to 25cm long. As the southern winter approaches around June, huge shoals migrate between the coastal waters of Cape Town and Durban. This, of course, is only a part of the attraction – as waiting in the wings to cash in on this vast, moveable feast is a huge array of marine predators, including sharks, dolphins, birds and whales.



Packing into a baitball

The sardines’ journey begins in the shallow, cool waters of the Agulhas Bank, just off South Africa’s southern tip. The fish congregate, possibly in their billions, to spawn in February and March, with the eggs and larvae then transported by currents to nursery grounds primarily located in the nutrient-rich waters along South Africa’s western coast. Here, they take two years to reach sexual maturity, while their parents undergo a migration in precisely

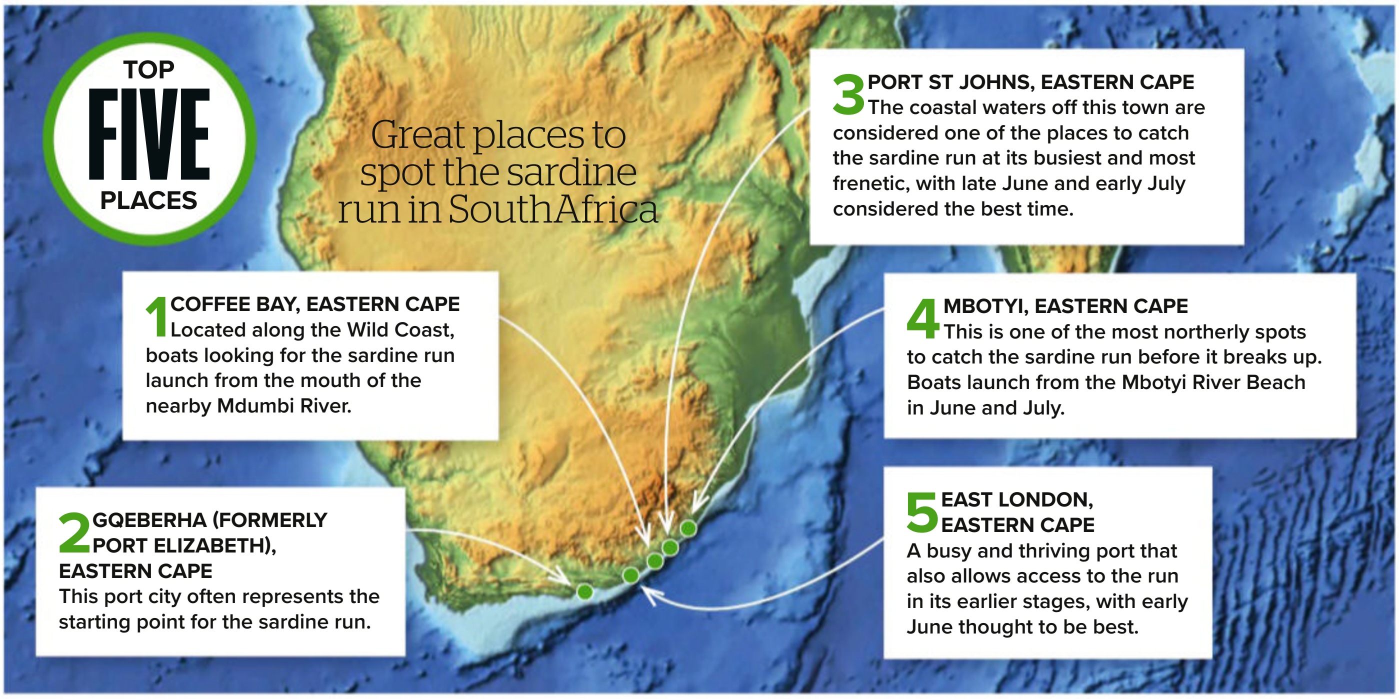
Did you know?

South African sardines inhabit shelf waters around 200m deep in temperatures of 14–21°C and live up to eight years. As they have short lifespans, numbers are impacted by environmental conditions.

> “Waiting in the wings to cash in on this vast, moveable feast is a huge array of marine predators”

BAITBALL: PETE OXFORD/NATUREPL.COM; SARDINES AND COMMON DOLPHINS: CHRIS & MONIQUE FALLOWS/NATUREPL.COM

Common dolphins prepare for a sardine feast off the South African coast



TOP FIVE PLACES

Great places to spot the sardine run in South Africa

1 COFFEE BAY, EASTERN CAPE
Located along the Wild Coast, boats looking for the sardine run launch from the mouth of the nearby Mdumbi River.

2 GQEBERHA (FORMERLY PORT ELIZABETH), EASTERN CAPE
This port city often represents the starting point for the sardine run.

3 PORT ST JOHNS, EASTERN CAPE
The coastal waters off this town are considered one of the places to catch the sardine run at its busiest and most frenetic, with late June and early July considered the best time.

4 MBOTYI, EASTERN CAPE
This is one of the most northerly spots to catch the sardine run before it breaks up. Boats launch from the Mbotyi River Beach in June and July.

5 EAST LONDON, EASTERN CAPE
A busy and thriving port that also allows access to the run in its earlier stages, with early June thought to be best.

the opposite direction. Following the cold, coastal currents, the mature sardines will initially move eastwards, before heading up South Africa's eastern shoreline.

With no immediately obvious benefits, the exact reasons for this mass migration are still not clearly understood, and for the sardines it appears little more than a one-way ticket. Preferring the colder waters found along the coast, the sardines are effectively penned in by warmer waters from the offshore Agulhas Current, which flows in the opposite (southerly) direction. While the numbers of fish are simply impossible to estimate, in good years mega-shoals can be more than 7km long, 1.5km wide and 30m deep.

In the early stages of migration, a few attendant Cape gannets appear to be the first sign the predators are closing in, but the game-changer is when the common dolphins arrive, any time between late May and early July. The only weapon the sardines possess is to dazzle the predators by well-coordinated and constant changes of direction. When all the sardines align their bodies with their immediate neighbours, the dense shoals alternate between light and dark with each synchronised twist and turn. The dolphins counter this behaviour by rounding up pockets of sardines with streams of bubbles, before forcing them closer to the surface to form 'baitballs'. With the dolphins trapping the sardines between the surface and the deep, blue sea, other predators then start piling in, with up to 18,000 common dolphins and thousands of copper sharks and Cape fur seals recorded in some years.

The sardines are not safe from above, either, as tens of thousands of Cape gannets plunge into the baitball from heights of up to 20m. During this period of no more than 20 minutes, the surface of the water appears to bubble, as the spectacle turns into a feeding frenzy. The pièce de résistance comes when a Bryde's whale lunges through the baitball with its mouth agape, gulping down water and possibly thousands of fish.

For any sardines who survive these onslaughts, the future appears no brighter. With Durban representing the end of the cold-water upwelling, the fish then seem to vanish. While some researchers have suggested a few may return south via deeper and colder water, it's believed most become trapped in subtropical and suboptimal temperatures and die.

The sardine run should never be taken for granted, as a whole food web depends on this seasonal bounty. Ⓦ

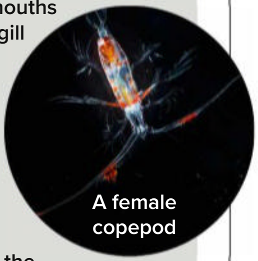
> "In good years mega-shoals can be more than 7km long, 1.5km wide and 30m deep"

Cape gannets dive into a mega-shoal of sardines off the coast of South Africa

LOOK CLOSER

Sardine food

Sardines mostly feed on zooplankton, with copepods making up the largest part of their diet. These tiny marine crustaceans (measuring 1–2mm) are harvested by a filter-feeding technique – the sardines swim slowly with their mouths open, as finely meshed gill rakers strain the food from the water.



A female copepod

A shiver of sharks

Despite the copper shark being the species most closely linked with the sardine run, a number of other species can be present in good years. These include blacktip and spinner sharks, along with an occasional appearance from the great white.

Cornish pilchards

Despite 21 species having been described as sardines, the European pilchard (or sardine) appears most closely related to the South African species. Found from Iceland down to Senegal, the main British fishery is in Cornwall, where it is caught in inshore waters from ports such as Newlyn and Mevagissey.

NEXT MONTH

On the tail of the immense, but rarely seen, whale shark

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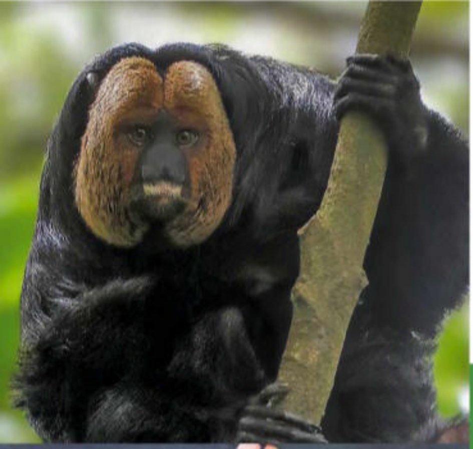

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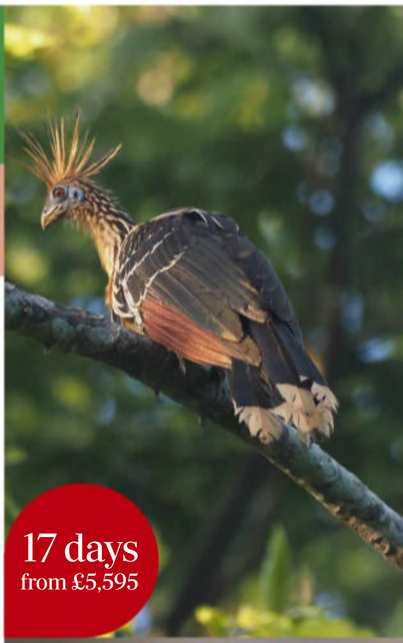

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HIDDEN WORLD

The popular naturalist, author and TV presenter reveals a secret realm of overlooked wildlife

SUPER FURRY ANIMAL

MONKEY SLUG

It's furry, tentacled and slides slowly over leaves. So... what the heck is it?

The monkey slug is not some experimental genetic monstrosity. But even if you see one in the flesh, you may still be unclear what this odd, brown hairy thing is, with its array of fuzzy tentacles. It moves over the surface of leaves with what can only be described as a lurching glide.

It's neither a monkey nor a slug, of course. This is *Phobetron pithecium* and it is the caterpillar of the hag moth, native to North America. The species belongs to the Limacodidae, a global family of moths that are collectively called cup moths or slug moths, depending on which part of the world you are in. The former refers to their cocoons, the latter to their unusual gait.

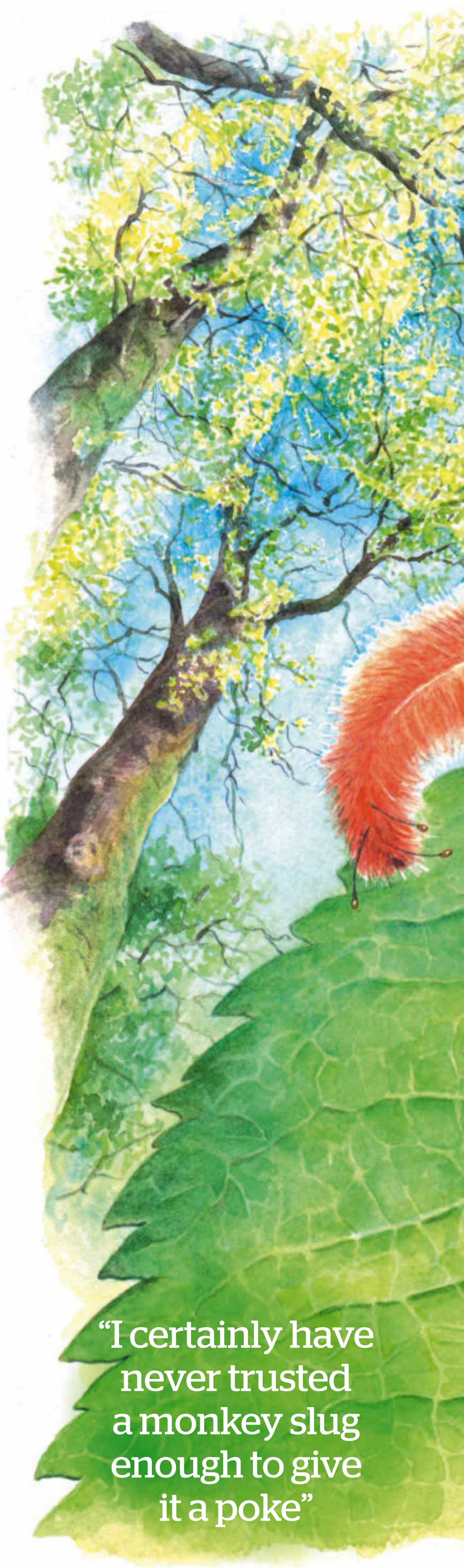
Think of a caterpillar and you'll probably picture a larva with six 'true' legs up front, coupled with varying numbers of simple organs called prolegs at the back. Prolegs are fleshy, gripping organs, each crowned with a fringe of hooked hairs called crochets.

However, the slug moths, including the monkey slug, are very different. If you were to watch one climbing up the side of a clear container, you would see a distinct lack of legs. The front ones are much reduced, and there are no prolegs as such either. Instead, the insect's underside is modified into a series of suckers, and it shuffles along on these in peristaltic (wave-like) movements. These body parts are hidden from view, making the caterpillar appear to glide along, even laying down a thin carpet of silk as it goes. There also appears to be no head (it's hidden beneath a cowl of fleshy folds).

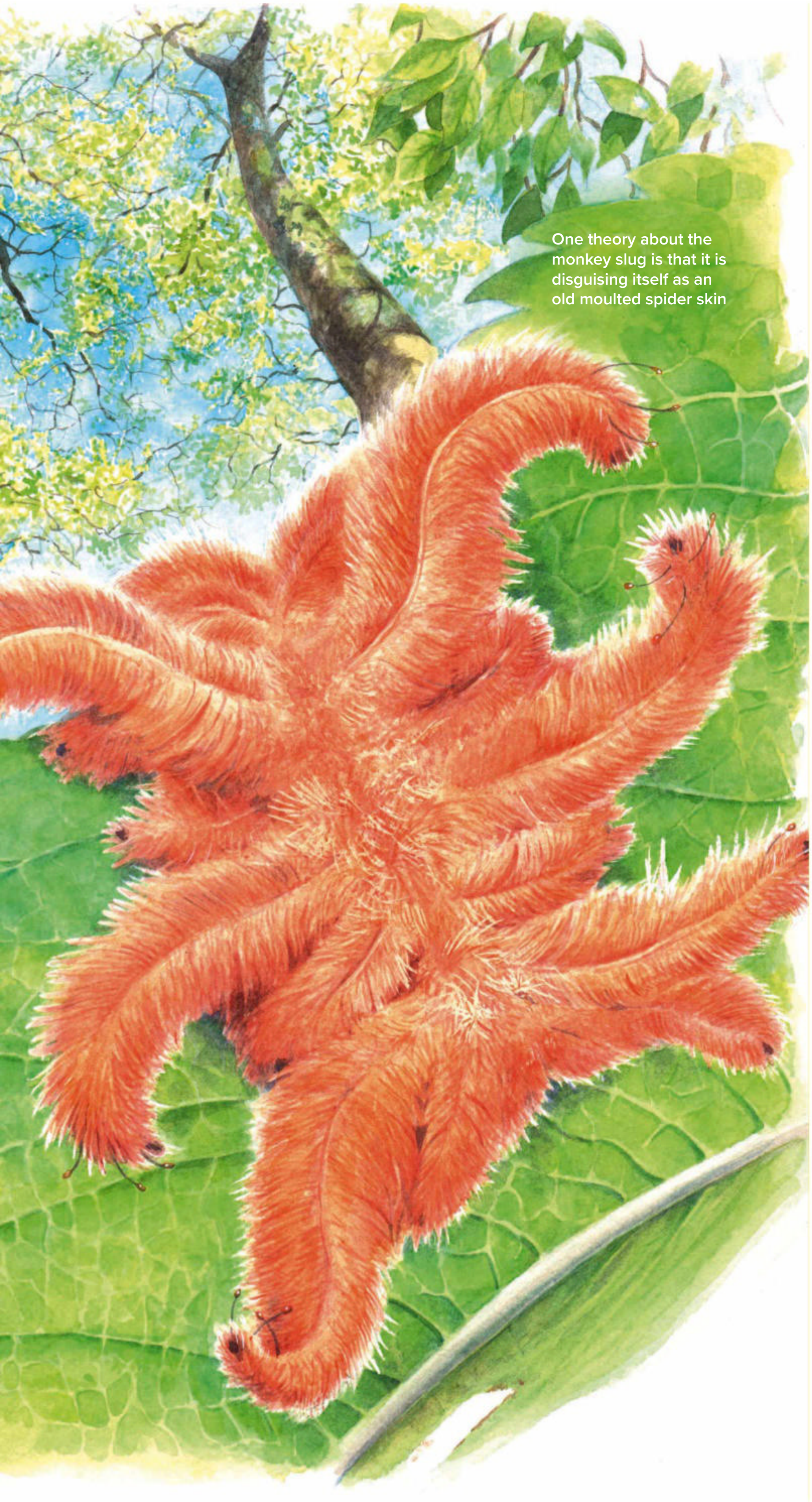
While this explains one aspect of the monkey slug's 'uncaterpillariness', for most people seeing one for the first time, there are other things to get to grips with. What are those 'tentacles' all about? The caterpillar almost seems to consist of nothing else, with nine pairs protruding out of either side of its body. Each is thick at the base, tapering to a curling point.

Among the other members of this family are numerous odd-looking, strange beasts. Some are lozenge-shaped, others are discs; some have fringes and frills; many are decked out in gaudy stripes, spots and blotches. They are a bright bunch that together resemble an alien pick and mix.

In nature, of course, this combination is a warning of something nasty unseen. Some of their common names bear this out, too –



"I certainly have never trusted a monkey slug enough to give it a poke"



One theory about the monkey slug is that it is disguising itself as an old moulted spider skin

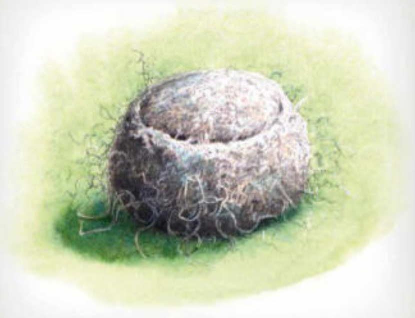
needle cats, nettle grubs, spitfires, warships and junks. Sure enough, many are armed with toxic spines, bristles and hairs.

While the monkey slug's scientific name translates as 'a frightening monkey thing', we might assume that it shares some of the family's traits. I certainly have never trusted a monkey slug enough to give it a cuddle – or even a poke with a bare finger. Look at one closely and those curling appendages are each covered in dense fur that comes in varying shades of brown. There are also lots more rigid black spines protruding from this forest of fluff. Then look below this wondrous wig and fringing the entire insect's body are even more tubercles, each armed with a barricade of even more stout hollow spines. So it looks like this is something to wonder at, but not touch.

The reality is that the world seems a bit confused. According to some sources, the monkey slug doesn't sting or deliver any urticating symptoms; according to others, it does – possibly a result of the varying degrees of sensitivity expressed by humans. It certainly isn't as bad as some creatures, where an accidental brush can leave you feeling like you've been licked by flames.

So, back to the question: why? One line of thought is camouflage: it doesn't look much like a caterpillar. This means it might get overlooked and, even if something does give it a peck, those 'tentacles' can break off, leaving its attacker with a mouth full of fuzz and not a lot else.

LOOK CLOSER



The cocoons hang between leaves

In the round

Slug moths are also known as cup moths due to their distinctive cocoons. (A weird caterpillar has to have a weird cocoon, right?) The cocoons are almost spherical and made from hardened silk, incorporating the caterpillars' larval hairs for continued protection through to adult life. Some even have a round 'hatch' that pops open, allowing the adult moth to emerge.

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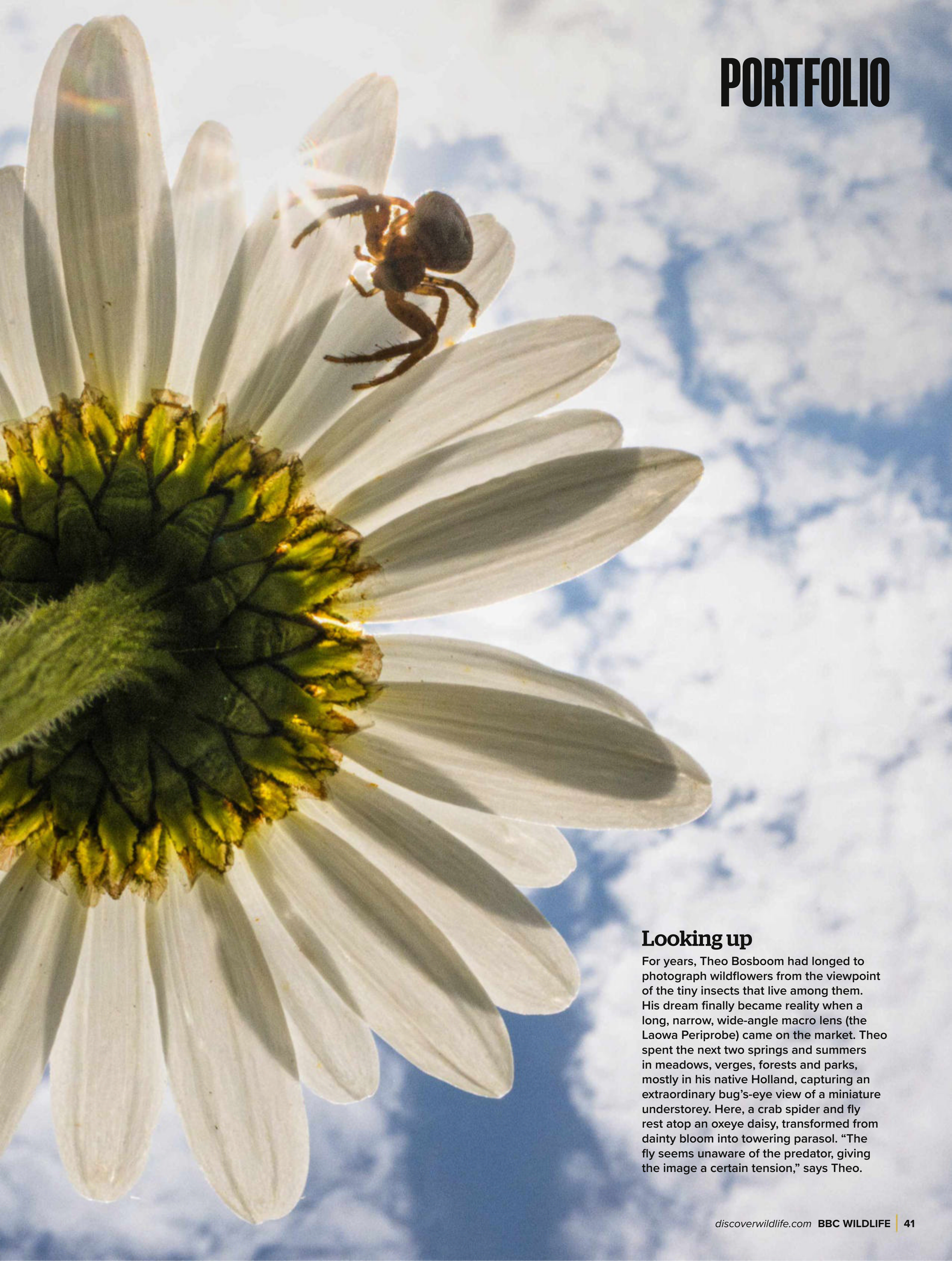
A BUG'S LIFE

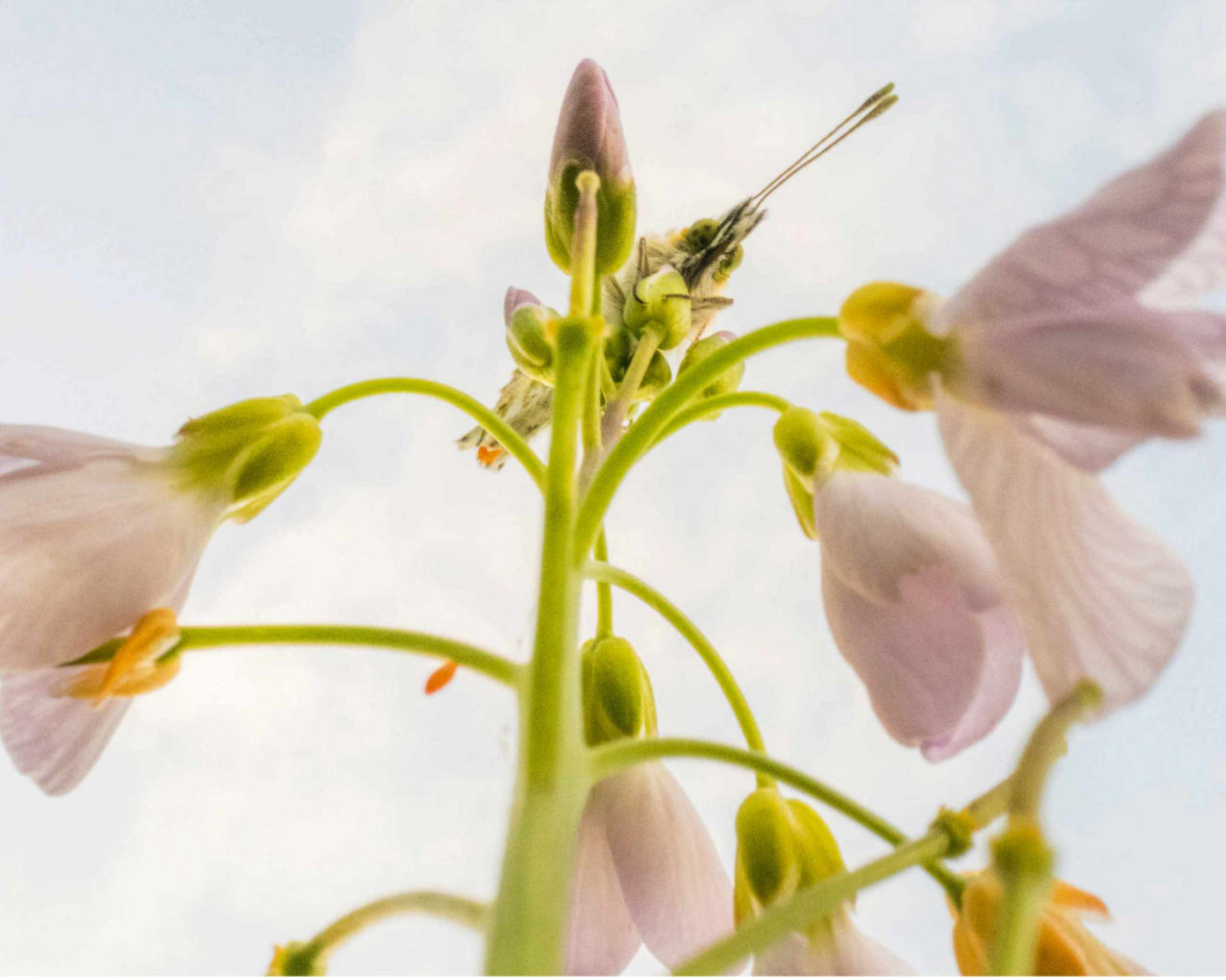
Photos by **THEO BOSBOOM**

Photographed from below, tiny flowers become towering trees. Theo Bosboom captures a captivating new perspective on life in the undergrowth



Looking up

For years, Theo Bosboom had longed to photograph wildflowers from the viewpoint of the tiny insects that live among them. His dream finally became reality when a long, narrow, wide-angle macro lens (the Laowa Periprobe) came on the market. Theo spent the next two springs and summers in meadows, verges, forests and parks, mostly in his native Holland, capturing an extraordinary bug's-eye view of a miniature understorey. Here, a crab spider and fly rest atop an oxeye daisy, transformed from dainty bloom into towering parasol. "The fly seems unaware of the predator, giving the image a certain tension," says Theo.

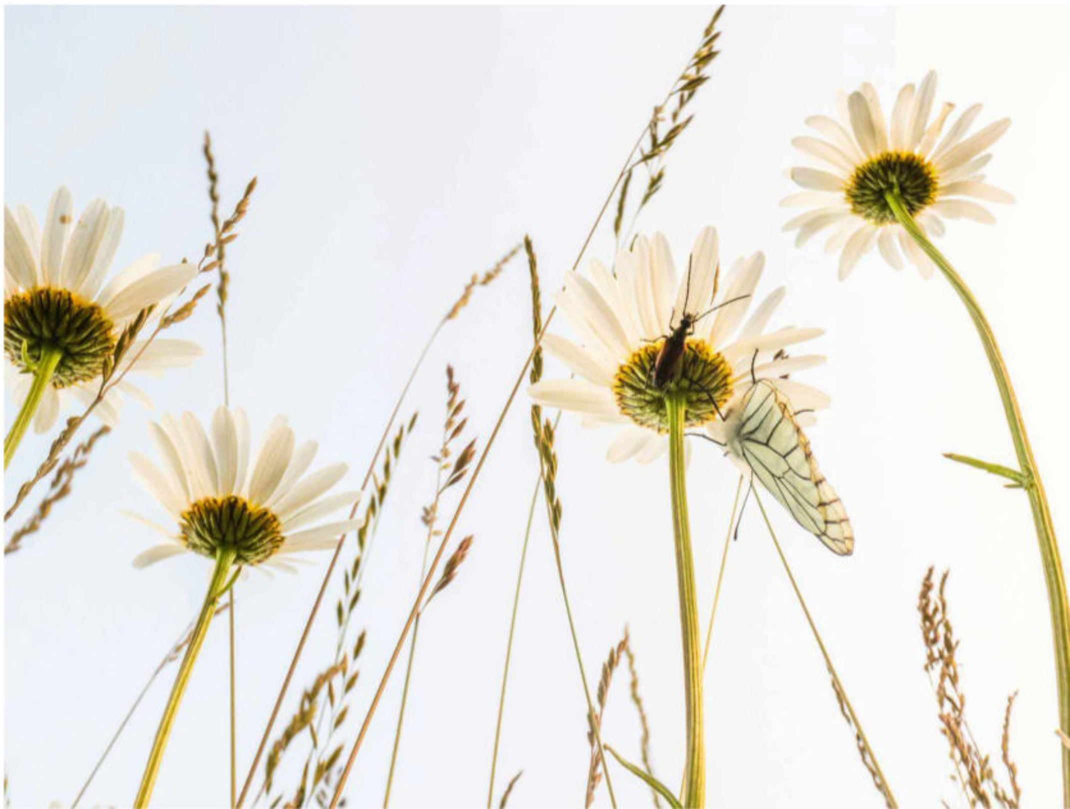


Eyes on the orange

An orange-tip butterfly perches on a cuckoo flower, one of the species' main foodplants. An orange egg is also visible on one of the side stems. Theo took this shot on a cold, windless morning – "perfect conditions for photographing butterflies, as they need to warm up before taking flight".

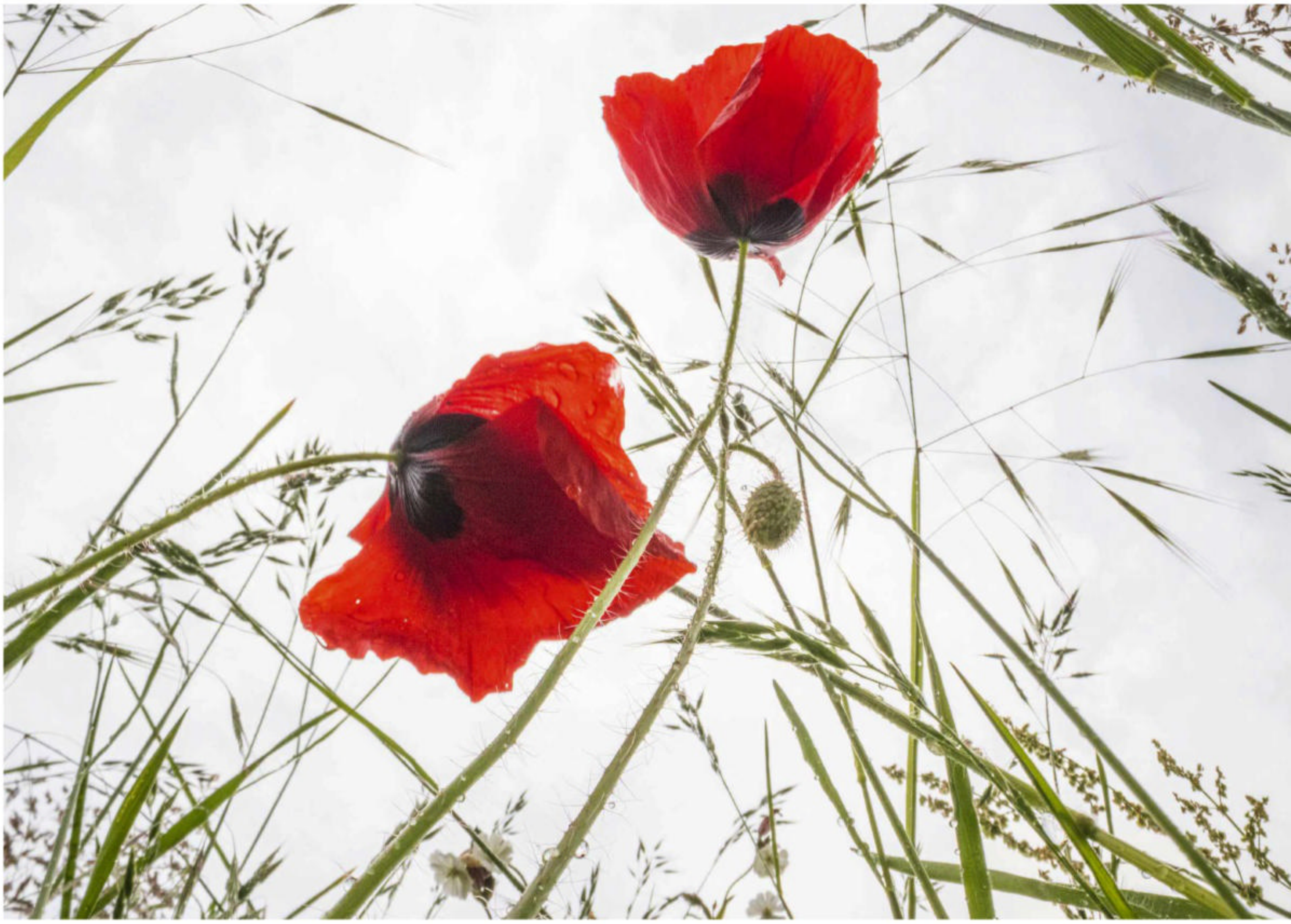
Fresh as daisies

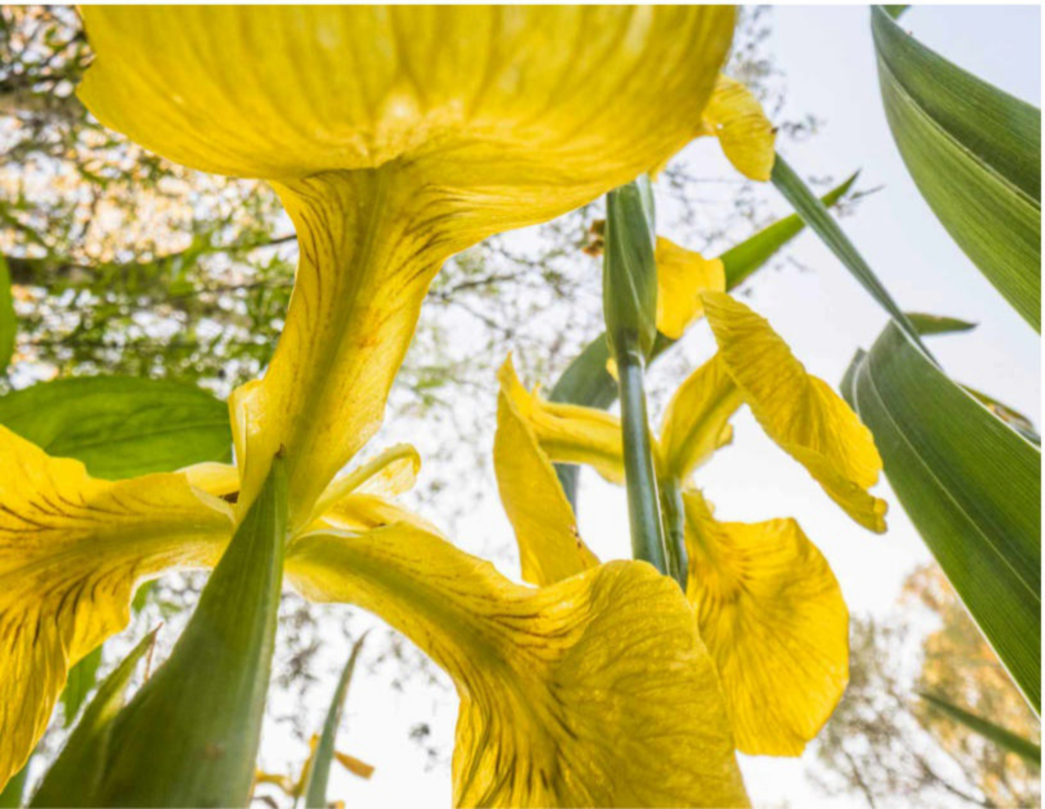
Alighting beside a longhorn beetle, a black-veined white rests among oxeye daisies in Viroinval, Belgium – an area known for its abundant butterflies.



ABOUT THE PHOTOGRAPHER

Theo is a wildlife photographer from Holland. His new book, *Flowerscapes: A Bug's Eye View* (DDB Publishers), is on sale now. Find out more at theobosboom.nl.



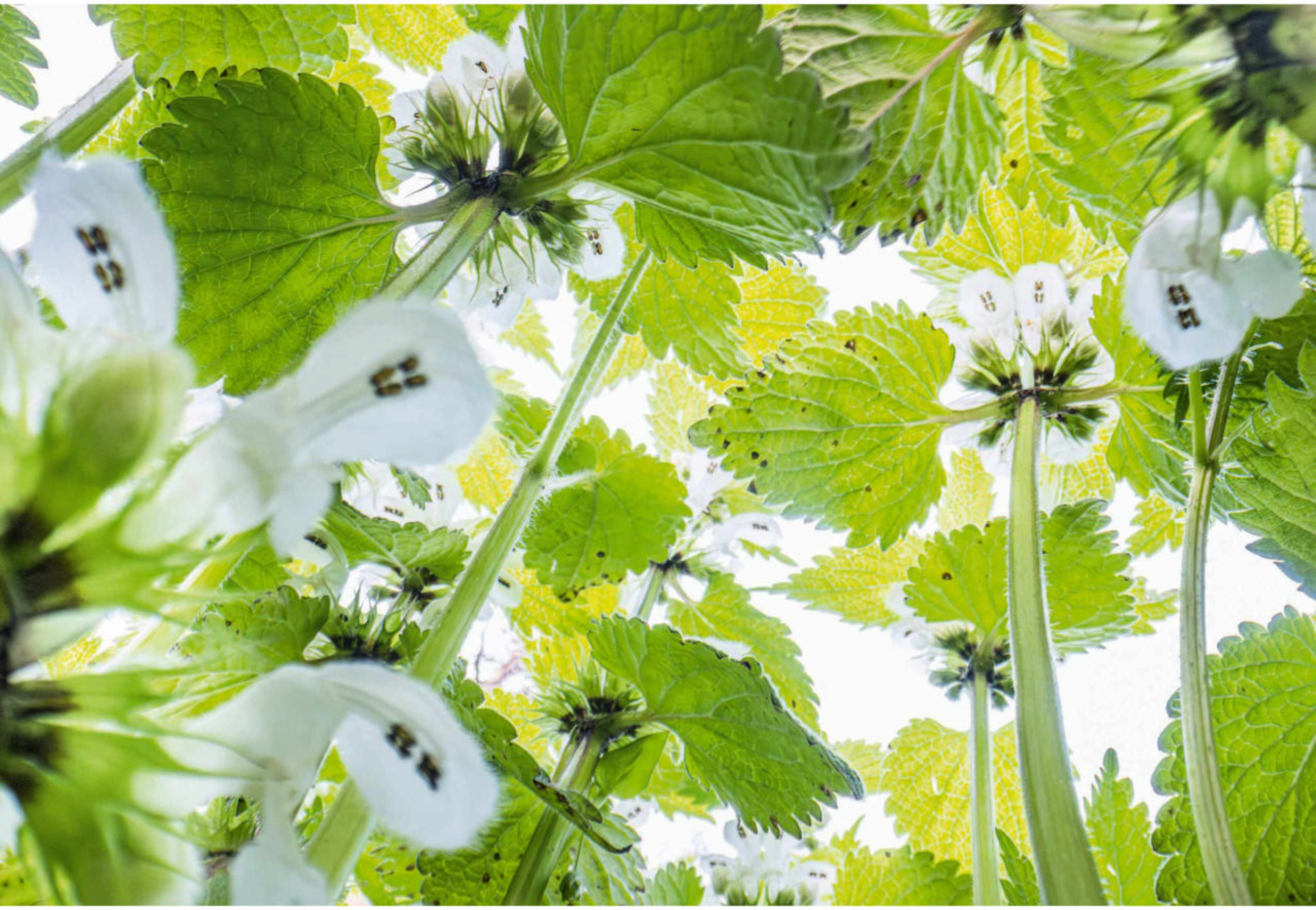


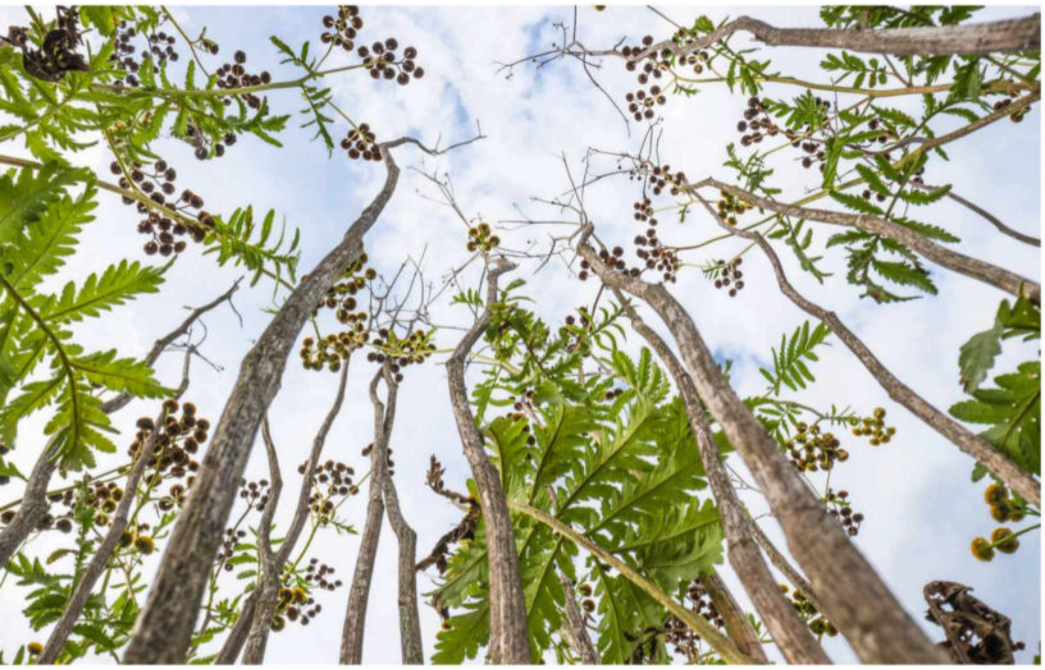
Downpour poppies

Raindrops tumble on to the stems of common poppies, photographed in a small meadow near Harderwijk. “Because my lens was pointing upwards, I had to clean it after each shot – and work very quickly,” says Theo.

Beauty in the bog

Yellow irises stand tall and elegant in Meinerswijk, a nature spot near Arnhem. “I was glad I was wearing wellies for this image,” recalls Theo. “The species prefers wet conditions, and I sank about 20cm into the mud.”



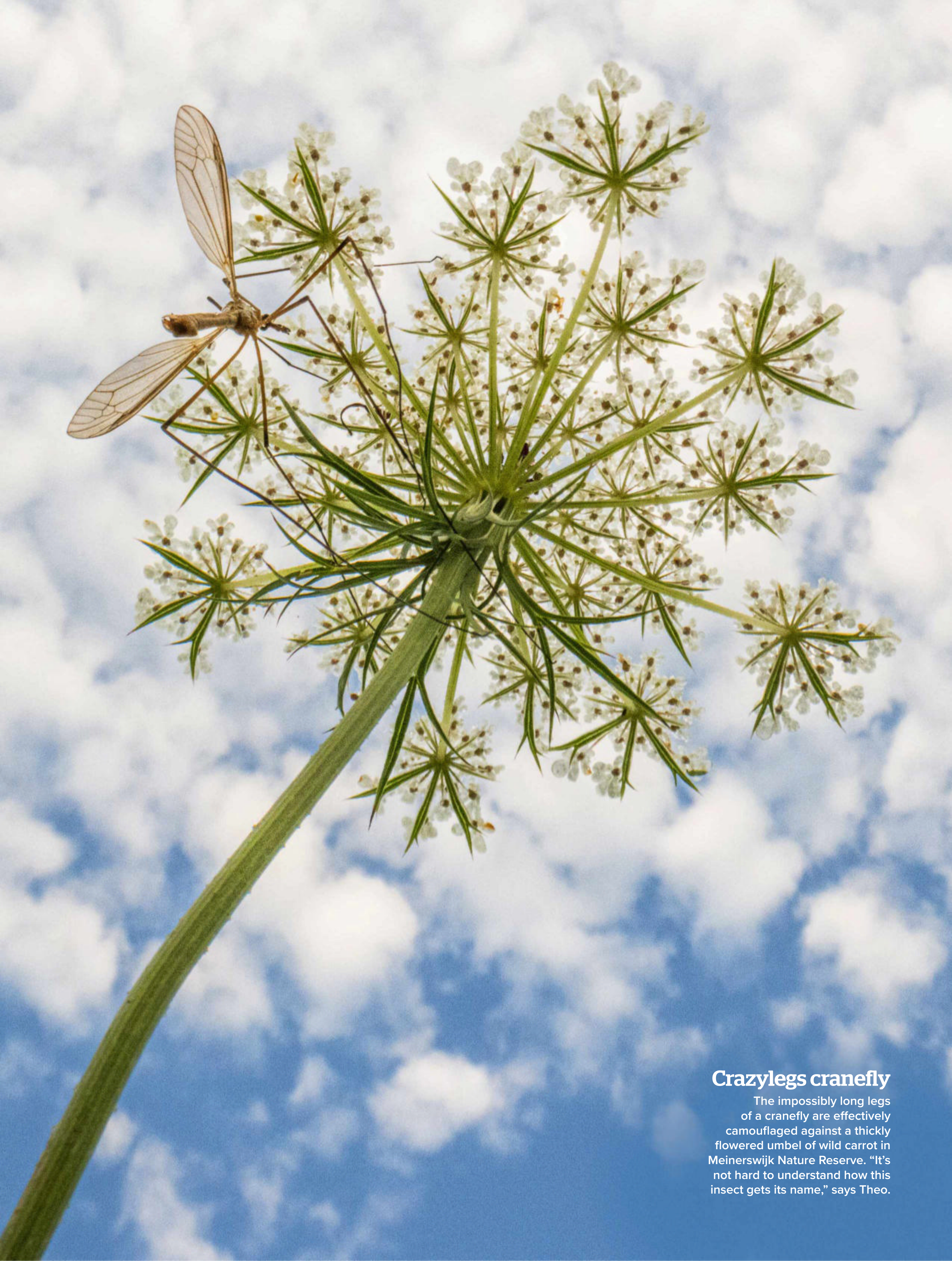


Getting nettled

Blooming on a forest path, a thick stand of white dead nettle evokes an alien-like jungle when viewed from within. “This was one of the most challenging images of the project – the leaves were close together and there was very little light under the plant,” says Theo. “I had to use an ISO of 6400, which is exceptionally high for plant photography. I carefully slid the probe between the leaves until I found an attractive composition.”

Reach for the sky

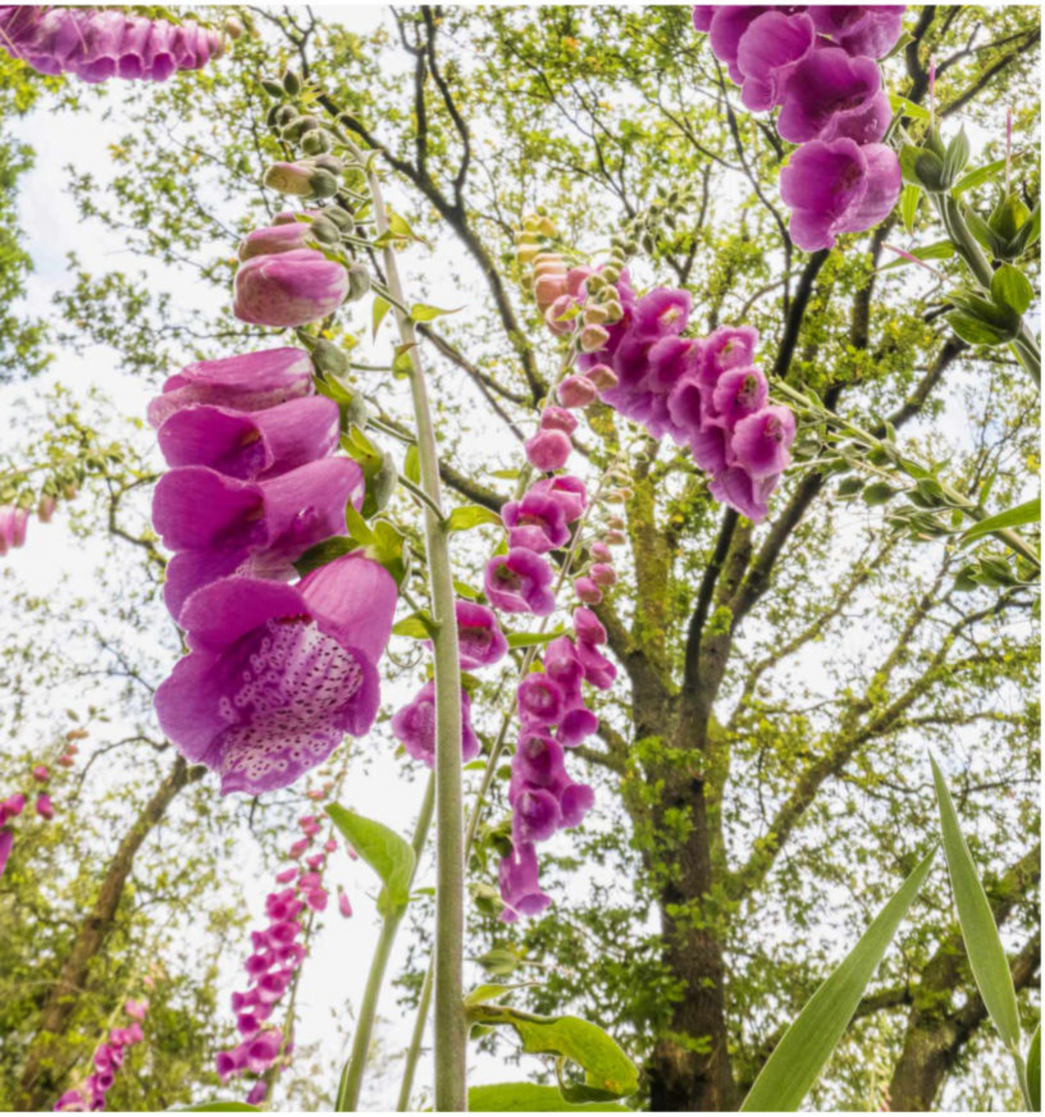
From a particularly low vantage point, the stems of tansy resemble twisting, lofty trunks, their yellow, button-like blooms taking on an entirely different appearance. Theo captured this shot in a fairly unremarkable field beside a roundabout.



Crazylegs cranefly

The impossibly long legs of a cranefly are effectively camouflaged against a thickly flowered umbel of wild carrot in Meinerswijk Nature Reserve. "It's not hard to understand how this insect gets its name," says Theo.

PORTFOLIO

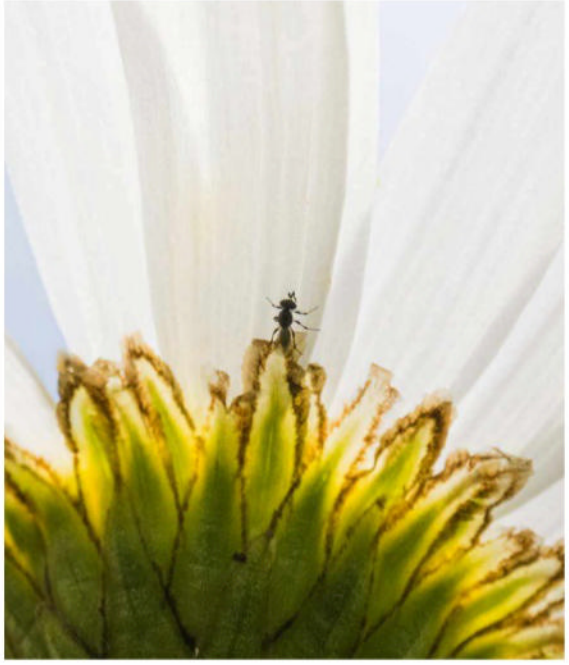


Not so mellow yellow

A cinnabar moth caterpillar trundles among the flowers of common ragwort. The plant is toxic, so farmers take care to ensure it doesn't make its way into livestock feed. After eating the plant, the caterpillar absorbs the toxins – hence its bold pattern and colouring, which serve as a warning to would-be predators.

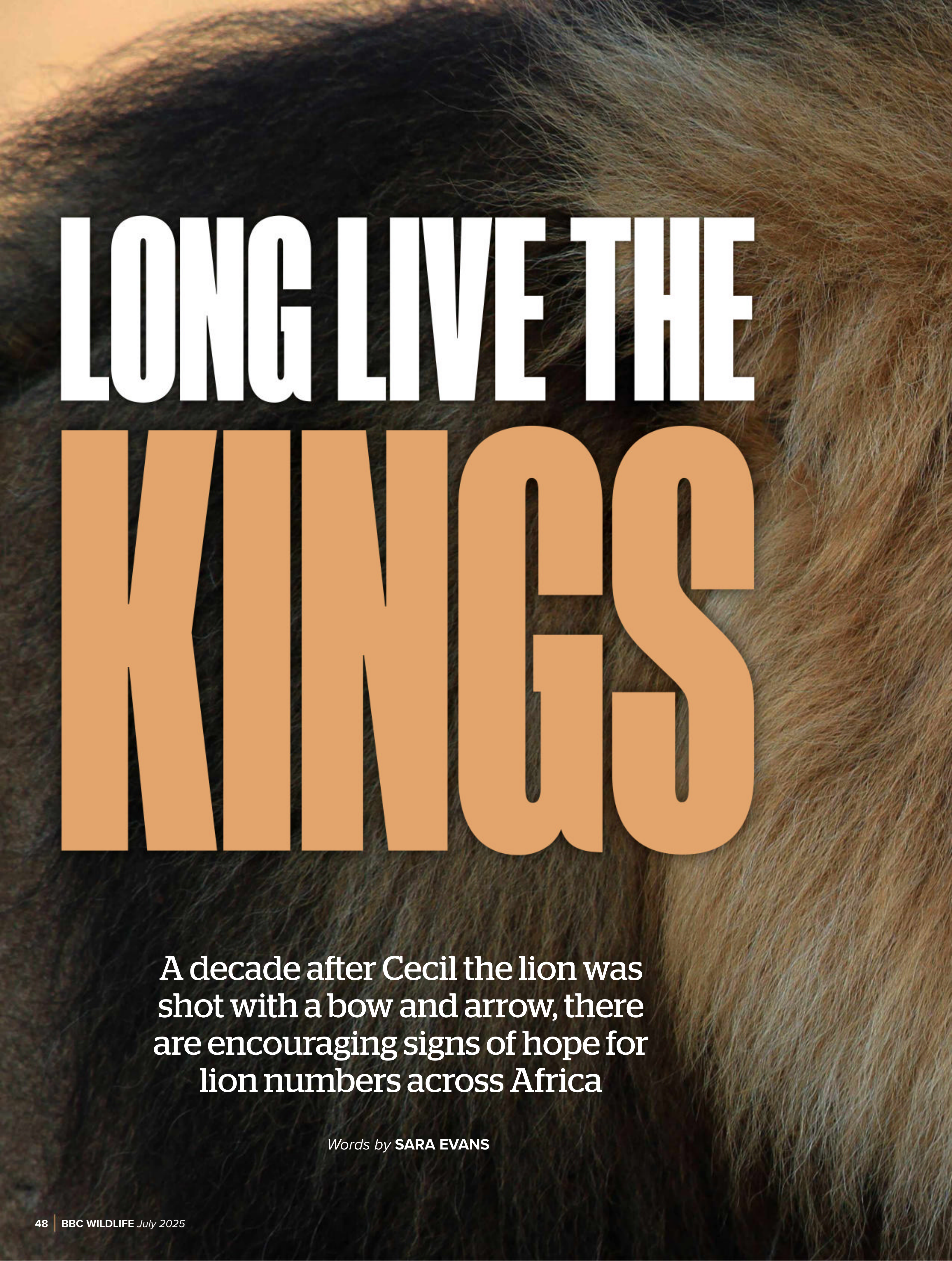
Shooting the breeze

Foxgloves add a bold splash of pink to a roadside verge near Theo's home town of Garderen. The spotted patterns inside the blooms are known as a nectar guides, which signal to visiting bees how to reach the nectar and pollen within. Foxgloves are tall flowers and exposed to the breeze, so Theo had to be patient to capture this image.



Daisy dweller

A minuscule fly, possibly from the grass fly family, appears even smaller captured among the silky petals of an oxeye daisy. From a normal vantage point, you'd likely not spot this little creature at all.



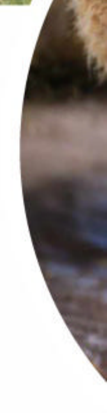
LONG LIVE THE KINGS

A decade after Cecil the lion was shot with a bow and arrow, there are encouraging signs of hope for lion numbers across Africa

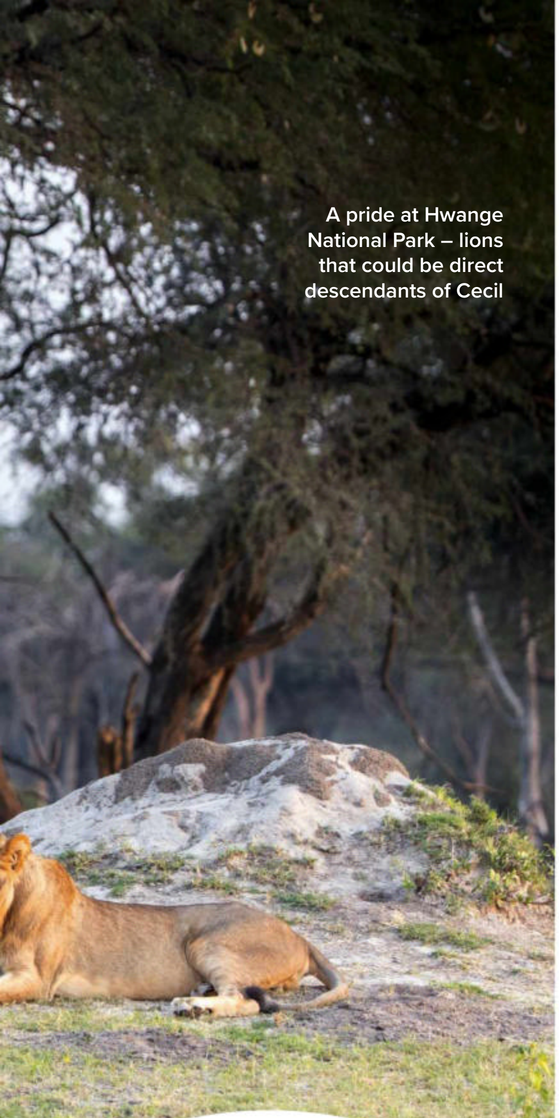
Words by **SARA EVANS**

The killing of Cecil
the lion 10 years
ago prompted
better awareness of
this at-risk species

CECIL THE LION: PAULA FRENCH/ALAMY



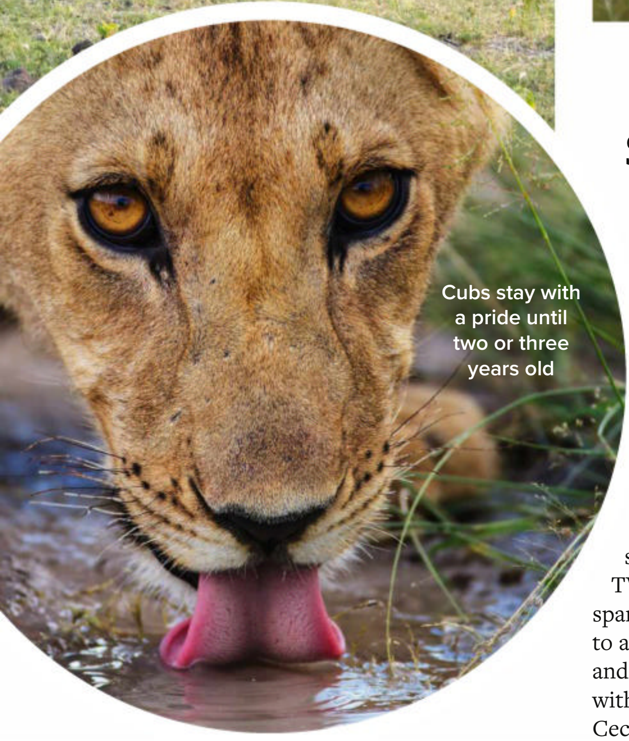
DO YOU REMEMBER CECIL THE LION, the bold, wild and archetypally handsome big cat at Zimbabwe's Hwange National Park? With a glorious flowing mane and a royal swagger, Cecil was the star attraction at the reserve for more than a decade. He was also a dominant male and established three prides, one of them 22-lions strong.



A pride at Hwange National Park – lions that could be direct descendants of Cecil

The male is very protective of its mate but will go on to breed with other partners

> “Cecil’s death lit a touchpaper, sparking an unprecedented global response to a wildlife story”



Cubs stay with a pride until two or three years old

But in July 2015, Cecil, who was named by a University of Oxford research team studying him and his pride, was lured outside the safety of Hwange’s border and killed by a trophy hunter.

Some weeks later, US comedian Jimmy Kimmel, with tears in his eyes, spoke about Cecil’s death on his popular TV chat show. This lit a touchpaper, sparking an unprecedented global response to a wildlife story. Social media channels and mainstream media outlets were jammed with comments about Cecil. Quite simply, Cecil set the internet alight.

There was, of course, outrage about the manner of Cecil’s death, but it also shone a light on lions more widely. People were shocked to learn that lions in Africa were in desperate decline. *Panthera leo*, the fabled king of beasts, an animal assumed to be invincible, was in trouble – big trouble.

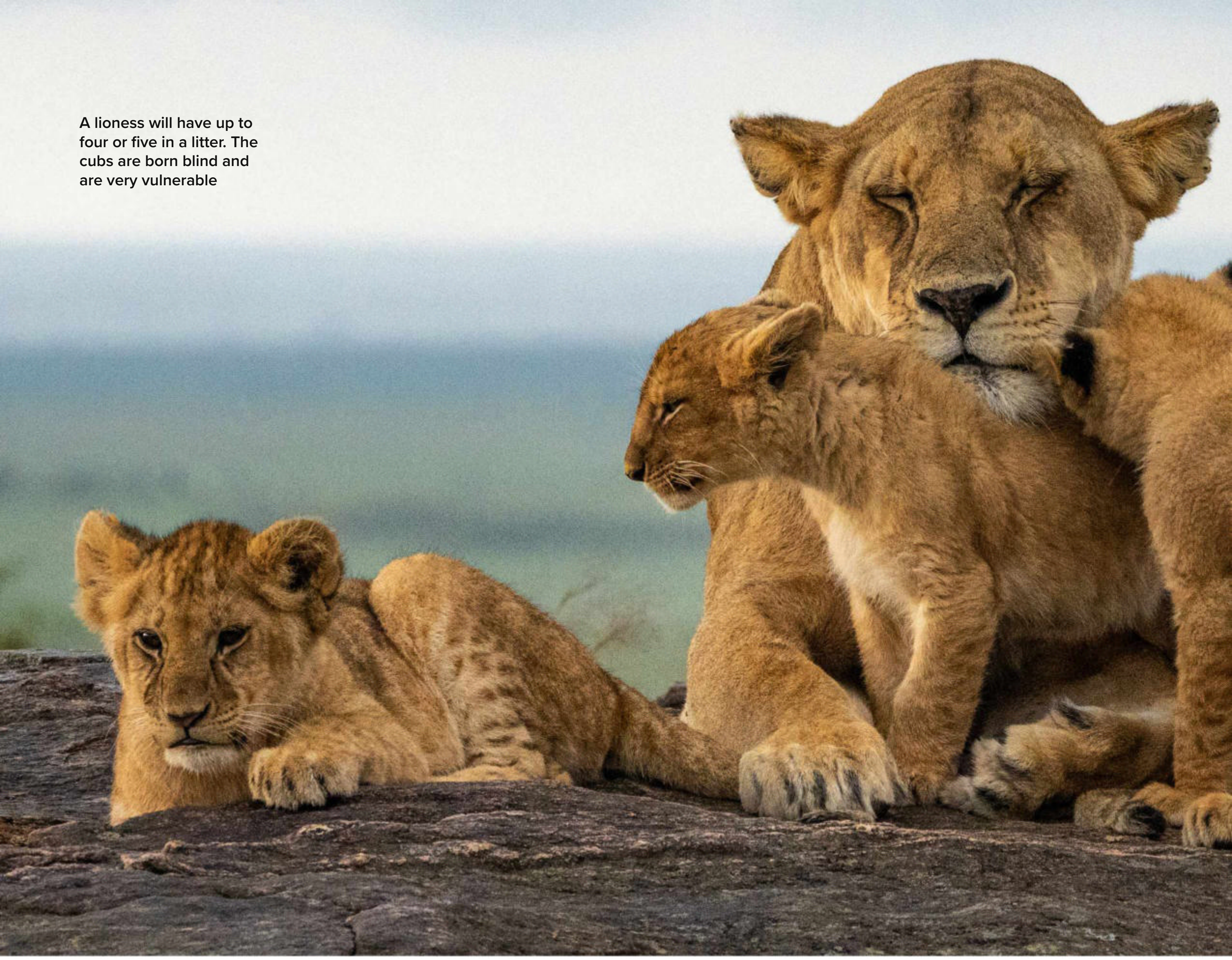
Across most of Africa, lion numbers were in freefall. Lions had actually been listed as Vulnerable by the IUCN since 1996, with estimates that no more than 29,000 individuals roamed the continent. In the north, lions were long gone, and in West Africa lion numbers were so low the IUCN categorised them as Critically Endangered. In all of Africa, the only lions doing relatively okay were some populations in Botswana, Namibia, South Africa and Zimbabwe.

TEN YEARS ON FROM CECIL’S death, the IUCN continues to categorise most lions as Vulnerable. The overall population trend is still one of decline, with lions in West Africa remaining listed as Critically Endangered, as no more than a couple of hundred lions remain in a tiny splinter – just 1 per cent of their former

ABOUT THE AUTHOR

Sara Evans is an award-winning travel writer and the author of the critically acclaimed *When The Last Lion Roars* (Bloomsbury).

LION PRIDE: SUZI ESZTERHAS/MINDEN/NATUREPL.COM; MALE AND FEMALE: ANUP SHAH/NATUREPL.COM; DRINKING: TONY HEALD/NATUREPL.COM



A lioness will have up to four or five in a litter. The cubs are born blind and are very vulnerable

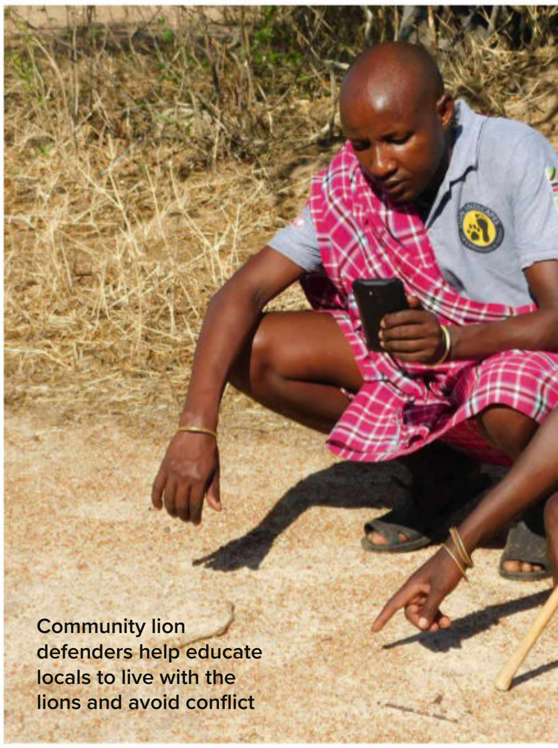
> “There are signs of recovery and evidence that population collapse is being resisted”

range. Hanging on by the most fragile of whiskers, these are the least protected and most endangered lions of all. Lions here have been described as the living dead, their populations so small and so fragmented there seems little hope for recovery.

But these lions have not been forgotten – far from it. There are signs of recovery and evidence that population collapse is being resisted. In south-east Senegal, in the Niokolo-Koba National Park, this could be down to a lioness called Florence. Caught on a camera-trap in 2023, she was a much longed-for sighting of a rare lion. But the even better news was that Florence wasn’t alone: she had three cubs with her.

Florence has had nine cubs. This may not seem like a large number, but Florence is actually responsible for almost a third of the park’s lion population. Her offspring are part of a growing population that has tripled since 2011, when 10 individuals were estimated to live here. By 2030, it’s predicted this number could rise to 100.

Around 90 per cent of West Africa’s lions are found at the W-Arly-Pendjari (WAP) Complex, a vast and critically important protected area comprising Pendjari National Park in Benin, Arly National Park in Burkina Faso and W National Park straddling the border between Benin, Burkina Faso and



Community lion defenders help educate locals to live with the lions and avoid conflict

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Conflict had all but eradicated lions in Sudan, until new sightings in 2022

Niger. While lion numbers here aren't increasing, against the odds – the area is affected by ongoing violence – the population is now stabilising and looks set to stay this way.

Andrew Loveridge, lion programme director at global wild cat conservation organisation Panthera, and part of the University of Oxford's Wildlife Conservation Research Unit (WildCRU), has extensive lion conservation experience in West Africa. He is encouraged by these good-news stories. "There's real scope for lions to recover here. There's certainly enough land. We have the will and the knowledge," he says. "In the right conditions, with the right funding, lions can bounce back. They are a resilient species."

There has been positive news in central Africa, too. In Chad, lions are benefitting from safe passage, using wildlife corridors that link protected areas. In 2024, in Chad's Sena Oura National Park, a healthy lioness of breeding age was caught on a remote camera – the first lion seen in the park for 20 years. It's thought she travelled here from neighbouring Bouba Ndjida National Park in Cameroon, where lion numbers are gradually increasing.

There is other good news for free-roaming lions in Chad. In 2022, a radio-collared male left Zakouma National Park in the south-east of the country and travelled 160km to Siniaka Minia National Park. A year earlier, a different radio-collared male made it safely to another protected area 40km away. Both lions were looking to establish prides in new territories.

There's lion-shaped hope, too, in South Sudan's conflict-affected Southern National Park. For years, scientists had been looking for lions, then out of the blue in 2022 a lion was captured on a camera trap. Just a year later, a pride seven lions strong was caught on cameras elsewhere in the park. Tracks were also spotted and roars heard at night. Some optimistic scientists tentatively estimate that perhaps up to 50 lions could be present here.

In Mozambique, there are similar signs of lion recovery. In 2021, a male lion appeared in the country's Zinave National Park – the first lion seen here in 30 years. A year later, this was followed by a sighting of a female and her cub, now settled at the park.

In some areas where lions haven't turned up under their own steam, they have been successfully reintroduced. In Malawi, lions were locally extinct from Majete Wildlife Reserve and Liwonde National Park. In 2012, Majete was first to hear lions roar again after an absence of three decades. In 2018, Liwonde welcomed the return of lions. Both areas now have populations described as flourishing, numbering more than 115 lions.

In 2018, 24 lions were translocated from South Africa to the Zambezi Delta region in Mozambique. In just two-and-a-half years, the new population reached around 64 individuals. And in Rwanda, where lions became extinct in the late 1990s, around 60 lions now thrive since an initial reintroduction of four lions in 2015.

MOTHER AND CUBS: KARA CAPALDO/GETTY; LION DEFENDERS: LION LANDSCAPES; CAMERA-TRAP PHOTO: FAUNA & FLORA/SOUTH SUDAN WILDLIFE SERVICE

AFRICAN BUFFALO BEING CAUGHT BY LIONS: JEZ BENNETT/GETTY

> "Lions are part of our land and our culture. I protect them because I want my children to see them too"

LOOK CLOSER

Threats to lions

In the past quarter of a century, Africa has lost more than half its lions. These are the main causes for this decline

Barbaric poaching instruments

THE BUSHMEAT TRADE The prey lions rely on, such as antelopes, is illegally hunted and sold. Lions go hungry and are killed by snares set for the other species.

POACHING Lions are killed for their skins, claws, teeth and bones to meet the growing demand for these body parts for ornamental or perceived medicinal value.

HUMAN-LION CONFLICT Violence between lions and people arises when lions attack livestock or humans, which often triggers retaliatory killings.

LAND ENCROACHMENT As the human population rises, there are increasing interactions between livestock, herders and lions, reducing habitat quality and increasing conflict.

LOSS OF HABITAT AND CONNECTIVITY Lions require large areas of habitat but this is being converted into smaller, isolated patches. This increases the chance of small populations dying out.

CEREMONIAL KILLING In some parts of Africa, lions are sometimes hunted and killed by local people as part of traditional rites of passage.

Lions clash with humans and their herds on remote farms

Elsewhere in Africa, community-led projects have empowered local people to help keep their remaining lions safe. In more remote regions, especially those outside of protected areas, conflict between big cats and people is an ongoing challenge. In East Africa, at least one lion a week is killed – shot, speared or poisoned – for taking livestock.

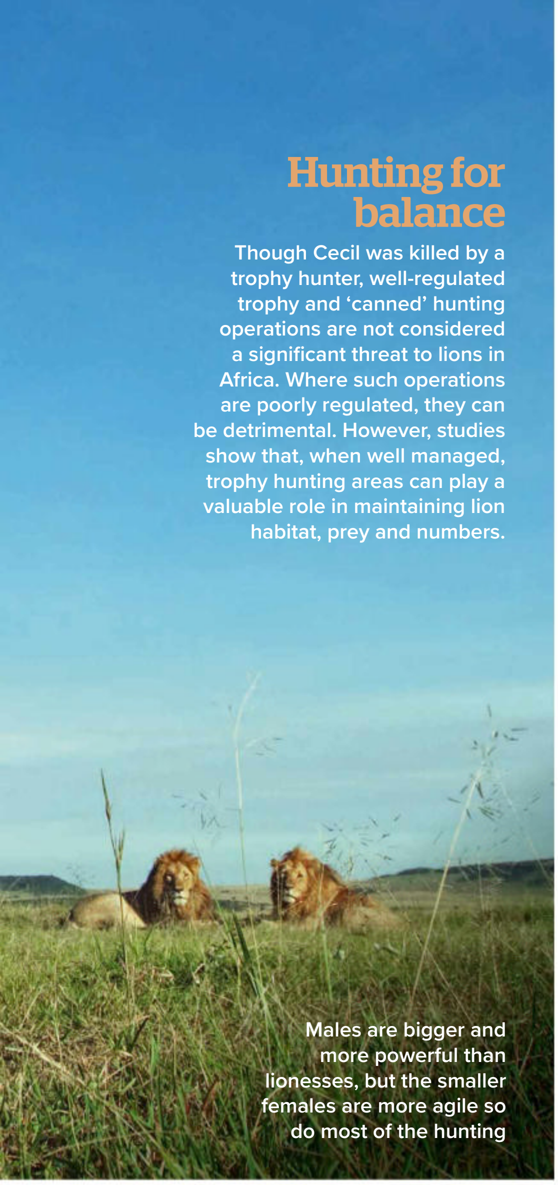
IN KENYA AND TANZANIA, conservation initiatives such as Lion Landscapes have been helping pastoral communities to find more lion-friendly methods of safeguarding their livestock and livelihoods against lion predation. In both countries, Lion Landscapes has employed and trained community liaison teams such as 'lion defenders' to reduce human-lion conflict and the killing of lions.

They help local people better protect their animals from lions, including reinforcing livestock enclosures (bomas), taking advantage of lion-detection warning systems and using special flickering lights to deter big cats from bomas. They have also developed community benefit initiatives, directly linked to wildlife presence. "I have chosen to protect the lion because they help make many things like roads, hospitals and schools," says Mandela, a lion defender from Tanzania. "This money comes because of the presence of lions."

In Zimbabwe, in 120 remote villages outside Matusadona National Park, there are community guardians who are employed and trained by Wildlife Conservation Action (WCA). They've had a significant impact in reducing retaliatory lion killings. Like the lion defenders, community guardians promote easy-to-operate methods for farmers to successfully protect their livestock from lion assaults. Such approaches have been adopted by more than 5,000 homesteads, reducing the killing of lions by 61 per cent. "Lions are part of our land and our culture. I protect them because I want my children to see them too," says community guardian Custardy Siachema. "With lion lights and mobile bomas, we can keep our livestock safe. They help us live peacefully with the lions."

Underpinning the practical measures used to prevent retaliatory killings, community-awareness programmes have helped people affected by lions to reframe how they view these predators. In many places, lions are now no longer seen as

MALE LIONS: ANUP SHAH/NATUREPL.COM; POACHING GEAR: SEBASTIAN KENNERKNECHT/ MINDEN/NATUREPL.COM; FARM: CHARLIE HAMILTON-JAMES/NATUREPL.COM



Hunting for balance

Though Cecil was killed by a trophy hunter, well-regulated trophy and 'canned' hunting operations are not considered a significant threat to lions in Africa. Where such operations are poorly regulated, they can be detrimental. However, studies show that, when well managed, trophy hunting areas can play a valuable role in maintaining lion habitat, prey and numbers.

Males are bigger and more powerful than lionesses, but the smaller females are more agile so do most of the hunting

After Cecil's death, Moreangels Mbizah set up Wildlife Conservation Action in Zimbabwe

HUNTING ZEBRA: DENIS-HUOT/NATUREPL.COM; MOREANGELS MBIZAH: GABBY SALAZAR

Two lionesses hunting a herd of zebra in Kenya

> "As a direct consequence of Cecil's death, lions here are safer than ever before"

a threat but rather as creatures of value that can bring many benefits.

In Kenya and Tanzania, where Maasai and Barabaig communities have hunted and killed lions for cultural reasons, lion defenders have been able to stop or prevent dozens of cultural lion killings. They enable young warriors to gain income and status from engaging in conservation rather than killings. This shift in cultural attitudes towards lions is vital, as support from local people is crucial for lion recovery. Without their positive involvement, the breakthrough lions recolonising West and Central Africa, the reintroduced lions in Mozambique, Malawi and Rwanda, and lions navigating ever-increasing threats all over the continent don't stand a chance.

For lion conservationist Amy Dickman, joint CEO of Lion Landscapes and director of Oxford's WildCRU, lions are best served by local people working at the heart of lion conservation. "The increasing focus on community-led conservation gives me hope," she says. "There are exciting cases of lion populations recovering and local people seeing lions as a benefit rather than a threat."

These aren't the only stories of hope for lions in Africa. All over the continent, projects big and small are making a difference. Lions are reclaiming their share, turning up where least expected, often in the most dangerous of places, and finding protection against some of the complex threats they face. They're also benefitting from the tolerance demonstrated by many pastoralist communities who share the land with them.

THESE TENTATIVE SIGNS OF lion recovery likely owe something to Cecil. When his death went viral, people responded generously and donated unheard of sums of money to conservation charities to help slow the decline of lions in Africa. Cecil's death also inspired people to join lion conservation projects or, even, like Moreangels Mbizah, set up their own lion-protection initiative.

Mbizah knew Cecil. She was part of the Oxford University research team at Hwange National Park and had studied the cat for three years. Mbizah was devastated by Cecil's death, describing it as a 'turning point' in her life. For Mbizah, the vulnerability of lions was heartbreaking. She had an overwhelming need to do something to safeguard the species.

"Inspired by Cecil's death," she says, "I went on to form my own organisation, Wildlife Conservation Action (WCA), in my home country of Zimbabwe with a clear mission: strengthening the capacity of local communities to mitigate human-wildlife conflict." And WCA's community guardians programme has been a success: as a direct consequence of Cecil's death, lions here are safer than ever before.

In some ways, Cecil's death acted as a catalyst for lion conservation, something Loveridge describes as a 'silver lining'. The lions showing up in Central and West Africa and elsewhere are evidence of this. For the momentum to continue, additional funding is needed – for more protection, for more community education and for more research.

Then hope for lions can become tangible. Lions that now exist in their tens and their hundreds could instead be counted in their thousands. And, above them all, Cecil's star can continue to shine brightly on.

“Beyond their magic and beauty, butterflies play a vital role in our ecosystems”

“Through their life-cycle, butterflies offer a masterclass in change, growth and renewal”

By **ASTRID VARGAS** *Illustration by* **DEBBIE POWELL**

When experiencing change in life, it’s wise to turn to nature for guidance. With billions of years of trial and error behind it, nature offers wise lessons on how we can adapt to new and unforeseen circumstances and events. As the ancient Greek philosopher Heraclitus said more than 2,500 years ago, “Change is the greatest constant in nature.” And few creatures do change quite like butterflies.

In a world where global warming, habitat loss and degradation, and biodiversity declines are quickly shaking things up, these colourful, wild pollinators remind us what transformation really looks like. Through their life-cycle – from crawling caterpillar to hidden chrysalis to adult winged wonder – butterflies offer a masterclass in change, growth and renewal.

My relationship with butterflies began in 2018 when I read an article about their silent declines. It caught me off-guard. I was aware of the bee crisis but hadn’t stopped to consider that butterflies, too, were disappearing before our eyes. I’d spent my life in conservation, working to restore endangered mammals, including the Iberian lynx in Spain, black-footed ferret in North America and golden-crowned sifaka in Madagascar, yet I’d never contemplated the possible extinction of an entire taxonomic group. So, I decided to raise and observe local butterfly species, such as the painted lady, the peacock and the small tortoise shell – partly to learn how to help them and partly out of awe.

As I delved deeper into this area, I discovered a miniature new world of astonishing complexity and beauty, a world that not only blew me away in terms of mind-boggling science and astonishing natural processes, but that also led me to reflect – often deeply – on life, death and everything in between. Butterflies, I realised, could impart great wisdom.

A butterfly’s journey begins as a minuscule egg, carefully placed on the perfect host-plant. The female detects the host-plant using her feet, which contain chemical receptors that function rather like tastebuds. Specific caterpillars can only feed on specific plants – brimstones, for example,

ABOUT THE AUTHOR

Astrid is a conservation biologist and author. Her latest book is *On a Butterfly’s Wing: Lessons from Nature on Embracing Change*. Find out more at onabutterflyswing.com.

“Watching my caterpillars shed in order to grow led me to contemplate the idea of letting go”

require buckthorn, while peacocks, commas and red admirals need the humble nettle – and survival is a matter of getting this right. If a butterfly lays her eggs on the wrong plant, her offspring won’t have anything to eat when they hatch.

Butterflies lay up to 1,300 eggs but fewer than half a dozen make it to adulthood. Once a caterpillar hatches from her tiny egg, life becomes a non-stop process of eating, defecating and shedding. All caterpillars go through five growth stages, known as instars, moulting and changing their appearance at each stage. In preparation for each moult, a caterpillar stops eating and becomes very still.

A CATERPILLAR CAN ONLY GROW by shedding its old skin. Its outer cuticle doesn’t stretch, so every few days the creature uses muscle contractions to build up the internal pressure of its hemolymph – the butterfly equivalent to blood – until the skin finally splits open along the back, like a dorsal zipper. Then, using powerful muscular contractions, it wriggles out of its old skin. With more than 4,000 muscles in their small, cylindrical bodies – compared to our 600 – caterpillars are remarkably well equipped for this task.

On the fifth and final moult, which occurs after about two weeks, a larva becomes more compact. Its cuticle hardens, forming the chrysalis. This is suspended by silk somewhere safe from predators and the risk of dehydration, ready for the ultimate transformation to take place within.

Watching my caterpillars shed in order to grow led me to contemplate the idea of letting go, and the importance of pausing now and then to reflect on what no longer serves us. As humans, we too can shed outdated habits, limiting beliefs or worn-out ways of thinking to make room for new possibilities. There’s wisdom in the way caterpillars develop: they don’t resist change, they embrace it, one transformation at a time.

What happens inside a chrysalis is nothing short of magic. Wrapped in its protective shield, the caterpillar’s tissues are broken down by enzymes known as caspases, and completely liquefy into a soup – what scientists refer to as ‘imaginal soup’. This nutrient-rich broth contains all the components of the caterpillar in a form ready to be reassembled into something wildly different.

As the caterpillar dissolves, specific cells become activated: the imaginal cells. These tiny pioneers arrive with a bold vision – they believe they can fly. At first, there aren’t many of them, but they multiply quickly, clustering together to supply building blocks to the imaginal discs, which are strategically located in different parts of the chrysalis. Each imaginal disc holds the blueprint for a specific body part: two new compound eyes (each of which contain 17,000 microscopic lenses), two antennae, six legs and, of course, four colourful wings. As the imaginal cells keep teaming up around the imaginal discs, the old caterpillar establishment quickly fades away, making room for the new.

IT TAKES BUTTERFLIES ABOUT 10 days to build their new bodies. During this time, they overhaul most of their systems – nervous, digestive, excretory, respiratory – to support their new life-forms. By the time they emerge from their chrysalises, they’ve recycled almost all of their caterpillar parts, with only a drop of red fluid, known as meconium, left behind.

Despite their dramatic transformation, they still carry the same DNA and fundamental building blocks they had as caterpillars. Yet, they emerge as a flying marvel of natural engineering, ready to thrive in a completely different ecological niche. Previous chewing jaws are now swapped for a proboscis – a long thin tube for sipping nectar. Legs are long and slender, and they now have reproductive organs. In short, while a caterpillar is optimised for eating, a butterfly is optimised for dispersal and reproduction. This complete metamorphosis – a trait shared by only some insect groups – is one of nature’s most astonishing transformations. Butterflies break down almost every part of their body, emerging with entirely new structures and capabilities. It’s a powerful reminder that meaningful change and growth, which may allow us to fulfil our potential, often requires a complete reset.

The more I learned about butterflies, the more captivated I became. One discovery that particularly amazed me came from a study carried out by scientists at Georgetown University. They discovered that butterflies can retain memories from their caterpillar stage, even after such a radical biological overhaul. The researchers trained caterpillars to associate a specific scent with a mild electric shock. After metamorphosis, they exposed the adults to the same scent. Remarkably, the butterflies reacted as if expecting the shock, suggesting the memory had persisted through the transformation. It’s a discovery that reveals surprising complexity in insect memory.

Some species of butterfly are among nature’s most remarkable travellers, and

> “As vital pollinators, butterflies play a key role in the ecosystems that sustain us”

the painted lady takes migration to a whole new level. Scientists at the Granollers Museum of Natural Sciences in Spain have been tracking painted ladies for decades, revealing that they undertake the longest migration of any butterfly. They can cover up to 14,000km, flying over continents, oceans and mountain ranges.

Some painted ladies have been tracked flying more than 4,000km without a single pit stop. In a 2024 study, researchers documented individuals completing a non-stop 4,200km transatlantic flight from West Africa to French Guiana. Their epic migration is an intergenerational endeavour, just like that of monarch butterflies, with each new generation instinctively picking up where the last one left off, continuing the journey without ever having flown it.

How do they know where to fly, you may wonder. Their navigational abilities are provided by their antennae, which come equipped with two compasses and a suite of sensors. Their sun compass helps butterflies track time and seasons based on the sun’s position, while their magnetic compass keeps them on course: flying north in spring and south in autumn. At the base of each antenna lies the Johnston’s organ – a tiny but powerful device that gathers information from the rest of the antenna, helping the insects to maintain balance and orientation during flight.

WITH THESE FINELY tuned instruments, painted ladies are ready for the long haul. They’ve been spotted soaring up to 1.5km above sea level, reaching speeds of 50kph when carried by favourable tailwinds. These small and apparently delicate creatures are capable of something epic, and when they migrate they’re demonstrating that strength is not just about power, but about endurance and strategy, persistence, timing and trusting one’s instincts to navigate the challenges ahead.

Beyond their magic and beauty, butterflies play a vital role in our ecosystems, both as bioindicators and as wild pollinators. Their presence – or alarming absence – can indicate the health of the environment around us. Right now, the message couldn’t be clearer: butterflies are in trouble.

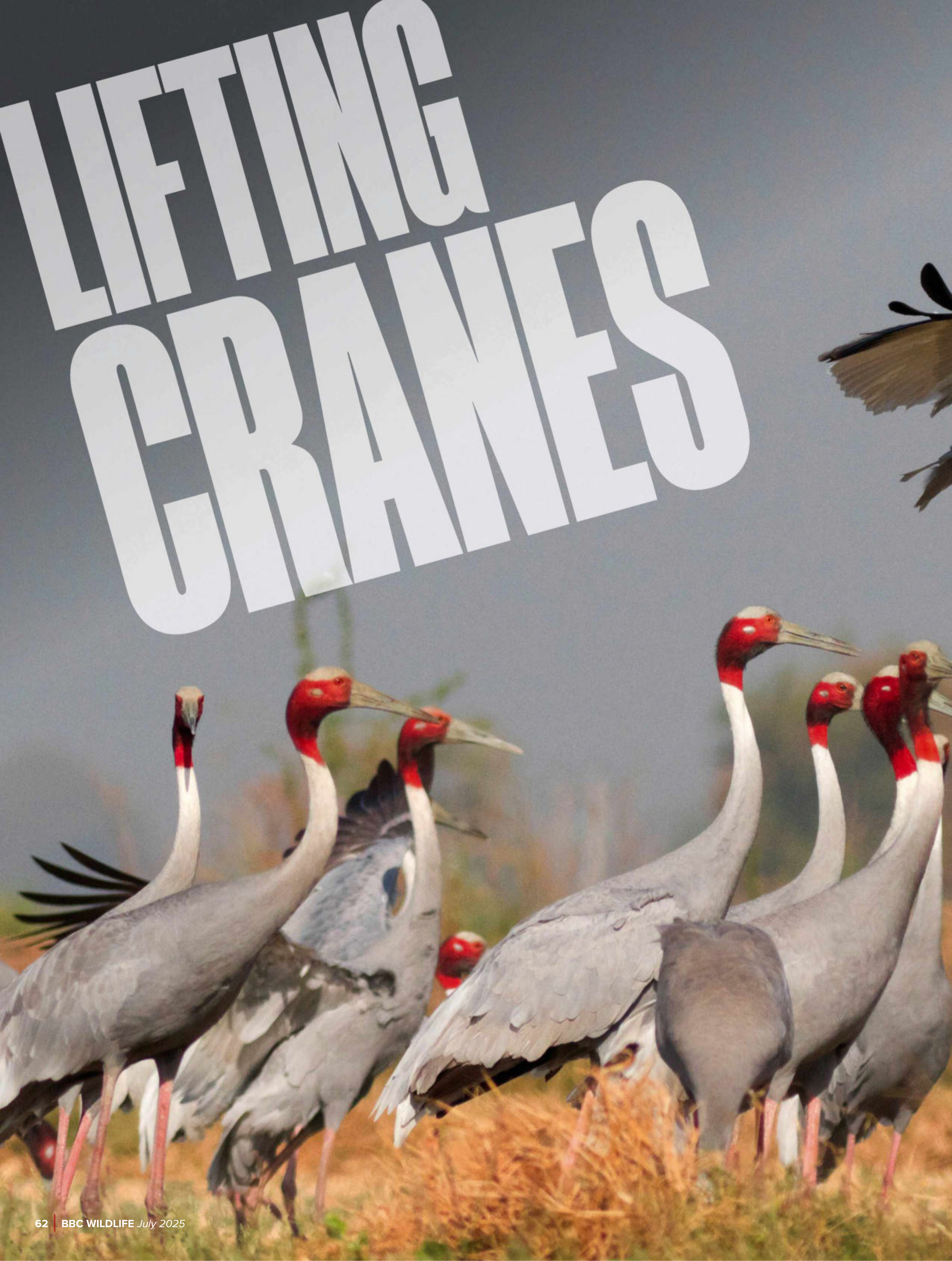
Worldwide, butterfly populations have plummeted by 70–80 per cent over the past 50 years. Some species, such as the once-abundant monarch in North America, have lost 95 per cent of their numbers along their western migratory route since 1980. Butterflies’ drastic decline is fuelled by habitat destruction, pesticide overuse, climate change and overconsumption.

As bioindicators, butterflies are the tip of the iceberg, signalling the broader environmental crisis unfolding. As pollinators, they also indicate a food crisis in the making. Bees, butterflies and other pollinators support 75 per cent of our food crops and nearly 90 per cent of wild flowering plants. Without them, food production will suffer and the challenges we already face will only intensify.

But there’s hope. When it comes to reversing the declines of butterflies, small actions can make a big difference. We can plant native, nectar-rich flowers to provide food; we can leave nature-friendly oases, such as patches of long grass and nettles; and we can avoid using pesticides and herbicides.

Butterflies teach us that transformation is a process of shedding the old and embracing the unknown. They inspire us to accept change, however daunting, and show us that by working together, we too can create positive transformations in our world. As vital pollinators, butterflies also play a key role in the ecosystems that sustain us. By protecting them, we’re not only safeguarding beauty and ecosystem function, but also our own future.

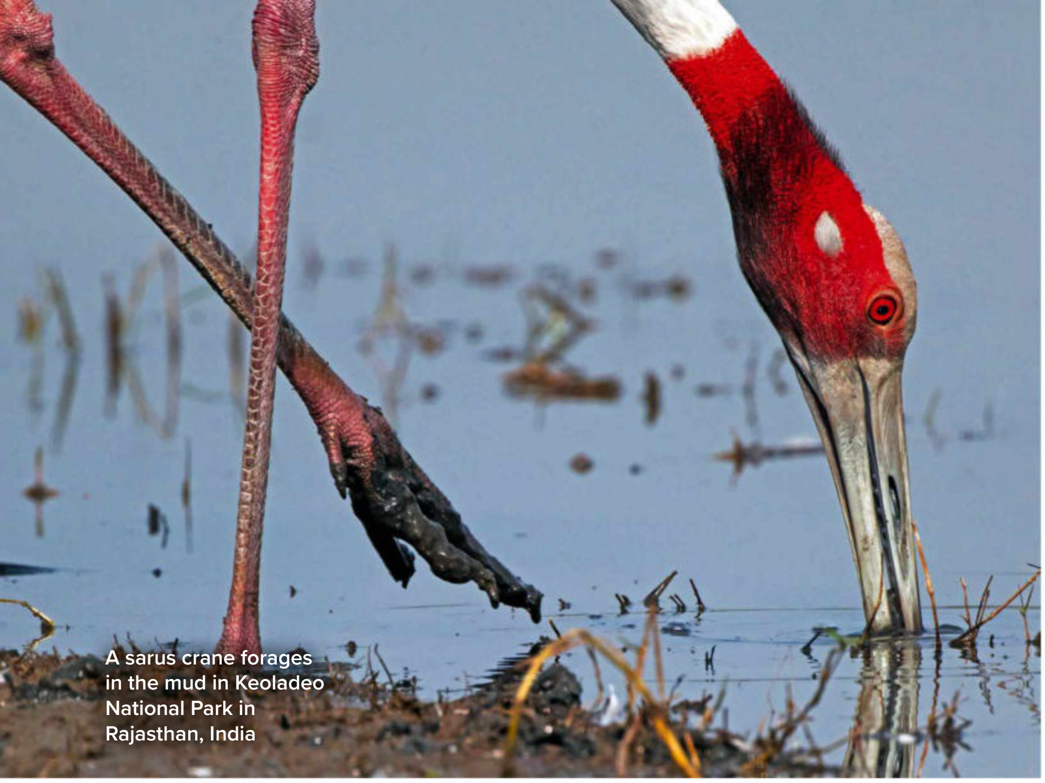
LIFTING CRANES

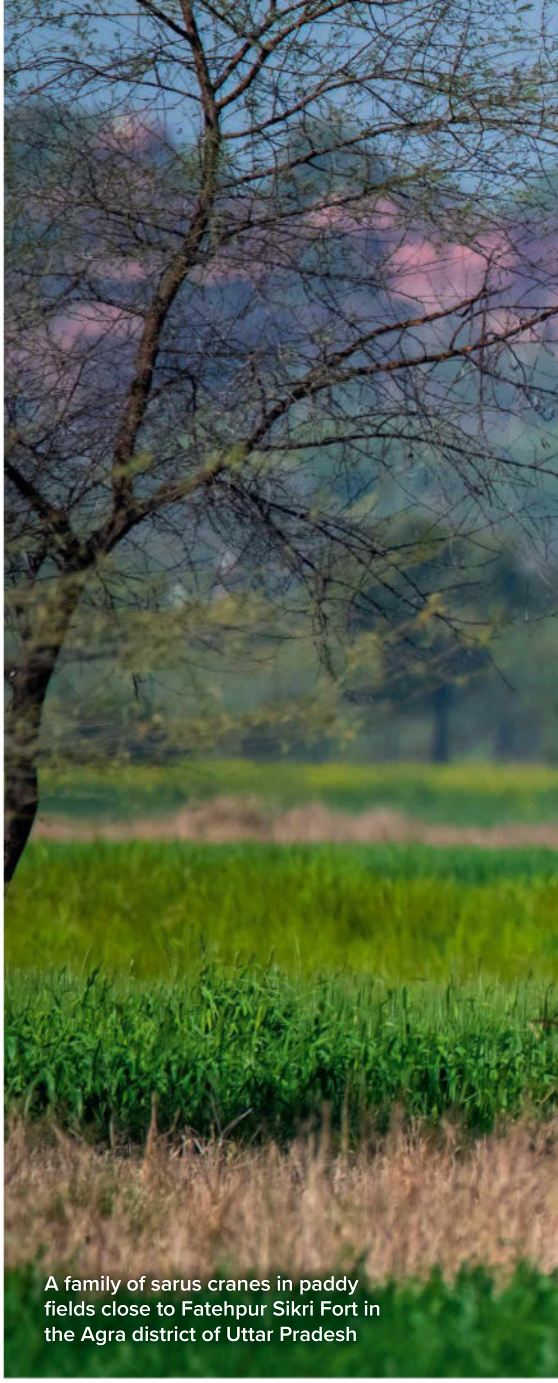


The tallest flying bird in the world owes its survival to a special relationship with small farmers in the most populated part of India

Words by **MOUSHUMI BASU**

CRANES: MANJEET & YOGRAJ JADEJA/ALAMY


A sarus crane forages in the mud in Keoladeo National Park in Rajasthan, India


A family of sarus cranes in paddy fields close to Fatehpur Sikri Fort in the Agra district of Uttar Pradesh

NASEERUDDIN ALI TAKES great pride in his home village of Madanpura, nestled in the northern reaches of the state of Uttar Pradesh in India, as it is one of the few locations where the world's tallest flying bird, the sarus crane, has chosen to settle and the only place where it is thriving.

Ali, a traditional farmer who sells his produce in the nearby town, often sees sarus cranes. He is excited when a pair suddenly appears. Flying with their necks outstretched and long legs trailing behind, these non-migratory waders cut a dramatic figure. Their heads, throats and upper necks are conspicuously crimson, set against white neck bands and dusky-grey breast and wing plumage. The duo gracefully descends on to Ali's half-a-hectare plot, flapping their mighty 2.5m-long wings and settling on to delicate pink legs to stand nearly 2m tall.

Many farmers in Uttar Pradesh believe these birds are indicators of a healthy agricultural ecosystem, and that their presence heralds a good harvest. "When they sweep past our fields, swaying the crops beneath them, they bestow fecundity and abundance to the land," says Ali, expressing his gratitude.

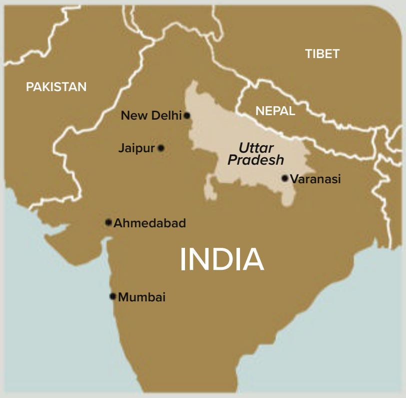
The term 'sarus' comes from the Sanskrit word *sarusa*, which translates as 'lake-dwelling bird' and, sure enough, the sarus crane loves water. A resident of flooded paddy fields, wetlands and ponds, it can often be seen ducking its head in the shallows and mud, foraging for tubers with its long, pointed bill, or probing for prey such as crabs, lobsters, fish and snails. On dry land, it also uses its beak to forage for seeds and grains, insects such as grasshoppers, and frogs.

Unfortunately, the sight of this charismatic bird filling skies and fields is becoming increasingly rare. In 2000, the species was listed as Vulnerable by the IUCN,

ABOUT THE AUTHOR

Moushumi Basu is a documentary film-maker. Some of the fields she works in are climate change, the environment and conservation.

Where is Uttar Pradesh?



Uttar Pradesh in northern central India is the most populated state in the country. It is a land featuring the vast plains of the Ganges and its tributaries, as well as the southern uplands.

having suffered a severe population decline. The species has faced myriad challenges in recent decades, including hunting and egg collection by humans and collisions with power lines. But the most significant threat to its survival has been the widespread degradation of its wetland home, developed, drained and converted to agriculture.

> “It’s India’s most populated state, yet Uttar Pradesh is the only place where the sarus crane is flourishing”

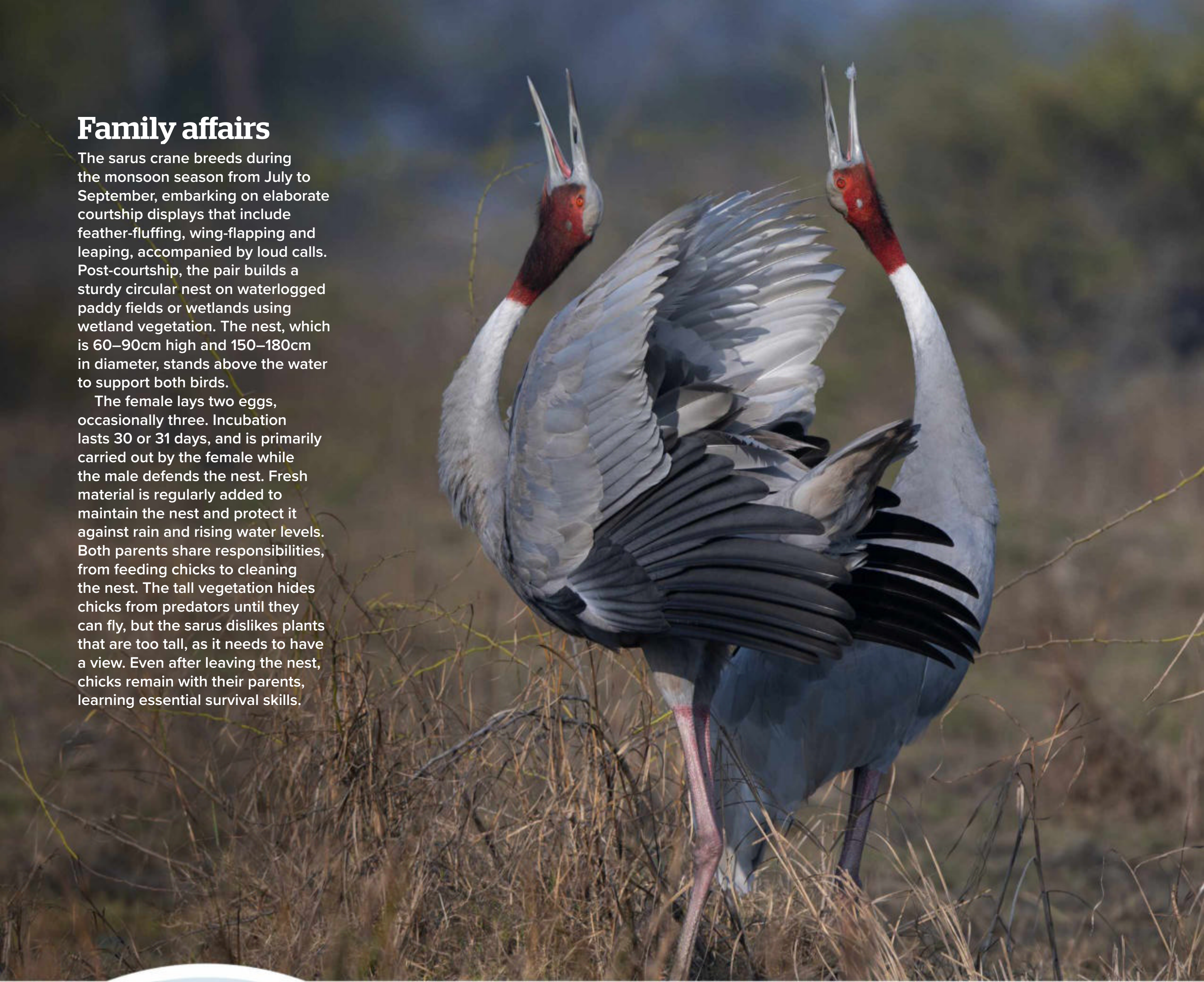
OVER THE PAST 50 YEARS, THE bird – one of 15 members of the crane family – has vanished from several of its former range countries, including Thailand, Malaysia and the Philippines. The global population of about 25,000–37,000 individuals is now comprised of three disjunct populations found in the Indian subcontinent (north and central India, Nepal and Pakistan); south-east Asia, where populations of a few hundred cling on in Laos, Myanmar, Cambodia and Vietnam; and the northern reaches of Australia, where flooded pits and troughs that provide water to cattle also support an estimated population of 5,000–10,000 birds.

The outlook for the species is bleak – yet Uttar Pradesh presents a happy conservation anomaly. Despite being the most populated state in India, it is the only location in the world where the sarus crane is flourishing. Numbers have risen steadily here in recent years, increasing from 17,329 individuals in 2021 to 19,918 in 2024. Indeed, Uttar Pradesh is now a stronghold for the sarus crane, accounting for 70–75 per cent of the species’ global population.

According to Neeraj Kumar, Uttar Pradesh’s chief conservator of forest, the birds primarily thrive in areas that retain the ideal mosaic of paddy fields and numerous small wetlands in close proximity. Many of the farmers in Uttar Pradesh are like Ali: most own small landholdings and have practised traditional farming for generations. It’s a way of life that suits the sarus perfectly.

After the monsoon season from July to September, the paddy landscapes of Uttar

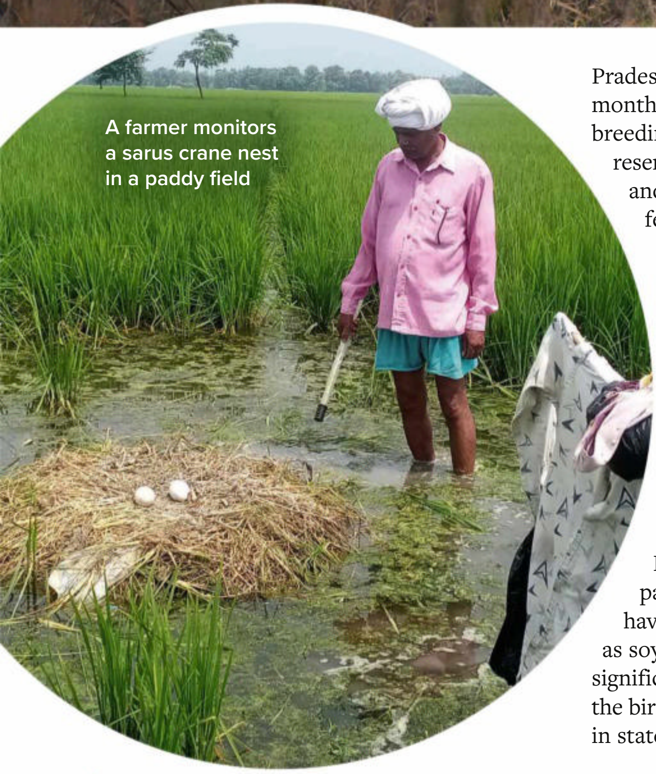
CRANE FEEDING: HIRA PUNJABI/ALAMY; THREE CRANES: RICK & NORA BOWERS/ALAMY



Family affairs

The sarus crane breeds during the monsoon season from July to September, embarking on elaborate courtship displays that include feather-fluffing, wing-flapping and leaping, accompanied by loud calls. Post-courtship, the pair builds a sturdy circular nest on waterlogged paddy fields or wetlands using wetland vegetation. The nest, which is 60–90cm high and 150–180cm in diameter, stands above the water to support both birds.

The female lays two eggs, occasionally three. Incubation lasts 30 or 31 days, and is primarily carried out by the female while the male defends the nest. Fresh material is regularly added to maintain the nest and protect it against rain and rising water levels. Both parents share responsibilities, from feeding chicks to cleaning the nest. The tall vegetation hides chicks from predators until they can fly, but the sarus dislikes plants that are too tall, as it needs to have a view. Even after leaving the nest, chicks remain with their parents, learning essential survival skills.



A farmer monitors a sarus crane nest in a paddy field

Pradesh remain flooded for three to four months, coinciding with the sarus crane's breeding season. The inundated fields closely resemble the crane's natural wetland home, and "the birds seem very happy to breed, feed and forage there," says Kumar.

ELSEWHERE IN INDIA, the bird is faring less well, having disappeared from many of its former range states due to changes in agriculture. This is a bird that needs an abundance of water, particularly during the breeding season. According to crane biologist KS Gopi Sunder, changing crop patterns (in which wet paddy crops have been replaced with dry crops such as soya beans, sugar cane and mint) have significantly reduced the habitat available to the birds. In the 1980s, the sarus was common in states such as Madhya Pradesh, Haryana and Maharashtra, yet sightings are now rare. Gujarat, on India's west coast, is a notable exception: the population here has nearly tripled in the past decade, increasing from 500 birds in 2015 to 1,431 in 2023–24, and now represents the second largest in India.

"Paddy plants grow to more or less the same height as the sarus crane, so the birds can still see their surroundings, and identify food sources and potential nest predators," says Sunder. "In contrast, the long, perennial grasses of sugar cane are taller than the birds and obstruct their view."

Large, mechanised farms also mean that food is less available and nesting is more dangerous. There is also the additional problem of pesticides, which the birds ingest when feeding on the seeds of treated crops. This severely affects calcium metabolism in the females, resulting in very weak eggs that are easily crushed during incubation.

The sarus crane tends to favour human landscapes that have little by way of nature protection. In 2013, the Wildlife Trust of

Two cranes take flight in Bera, Rajasthan. These large birds live mostly in pairs or small groups

India (WTI) launched the Sarus Crane Conservation Project (later also known as the Sarus Habitat Securement Project), in collaboration with partners including Tata Trusts and the World Land Trust, to protect the bird and its habitat across 10 districts of eastern Uttar Pradesh. To support this effort, the species was designated as the state bird of Uttar Pradesh the following year.

If the sarus was to thrive here, it was vital that the farmers were involved in the conservation effort, as not all of them shared Ali's affection for the species, given its occasional propensity to damage crops. "It was important for farmers to be an integral part of conservation strategies to save the sarus, as it would foster a sense of belonging towards it," says Samir Kumar Sinha, chief ecologist at WTI.

Farmers were duly advised on the ecological importance of the sarus crane and the value of minimising agrochemical use, but a particularly key strategy was to revive the bird's rich historical and folkloric significance. The farmers were reminded, for instance, of the ancient story of Buddha as a child, then known as Prince Siddhārtha. Siddhārtha rescued a sarus crane that had been struck by an arrow fired by his cousin, Devdatta. When Siddhārtha refused to hand over the bird, the dispute escalated to the royal court. It decided in Siddhārtha's favour, upholding the right of the saviour over that of the destroyer.

Uttar Pradesh is also home to several sacred sites associated with significant events in Buddha's life, such as Shravasti, where he spent part of his monastic life, and Kushinagar, where he died. "The flourishing of sarus cranes in these regions signifies a unique convergence between their conservation and the legacy of Buddha," says Arshad Hussain, field head of the project. "Today, the bird enjoys deep cultural, mythological and ecological significance in the villages of Uttar Pradesh."

The sarus crane's breeding habits also helped to win hearts and minds, as it is known to pair for life. If one partner dies, the other is said to pine for days and, in most cases, to remain single for the rest of its life. "This incredibly romantic and monogamous bird is a symbol for love and is the epitome of marital fidelity," says local farmer Ravindra Kumar Tripathi, who has been monitoring the birds for a decade. "Right from building the nest to caring for the chicks and even cleaning the nests, the pair shares responsibilities."

Ali says most farmers now consider themselves fortunate when sarus cranes breed on their farms, often overlooking any minor damage they might cause. "They are natural pest controllers, preying on the insects and rats in our fields, and save us the cost of chemical pesticides and crop loss," says Ali. The birds are also useful wardens, their loud, trumpeting calls alerting farmers to crop raids by blue bulls or other animals.

The local farmers who form the backbone of the WTI's Sarus Crane Conservation Project now comprise an extensive network, and collaborate closely with a 147-strong community volunteer team called *Sarus Mitra* ('friends of Sarus'). From spreading awareness of the species, monitoring them and protecting nests and eggs, to assisting in biannual counts, the villagers ensure their cranes are safeguarded.

Sarus cranes, even with young, happily co-exist alongside humans in Uttar Pradesh

The WTI team no longer has to invest in breeding surveys, as villagers inform them as soon as the birds begin building nests or laying eggs in their villages. Spotting a nest is easy, as the cranes use wetland vegetation to build large structures on the ground. They return to the same nest sites each year, rebuilding nests if they are not disturbed. "The farmers are the best nest protectors – they carry out a constant vigil," says Hussain.

All these efforts are paying off. According to official figures from the WTI, the population of sarus cranes in these 10 districts is up almost fourfold, from 681 in the initial survey in 2013 to 2,679 in December 2024. It's an impressive recovery, yet other challenges remain. "Power lines are here to stay, so our focus is on breeding success to compensate for those losses," says Hussain. And that means securing the sarus crane's wetland home, and allowing these iconic birds to reclaim their lost habitats.

"A particularly key strategy was to revive the bird's rich historical and folkloric significance"

DISPLAYING CRANES: BERNARD CASTELEIN/NATUREPL.COM; FARMER BY NEST: ARSHAD HUSSAIN; CRANES IN FLIGHT: EPHOTOCORP/ALAMY; ADULTS AND CHICK: SAMIR KUMAR SINHA

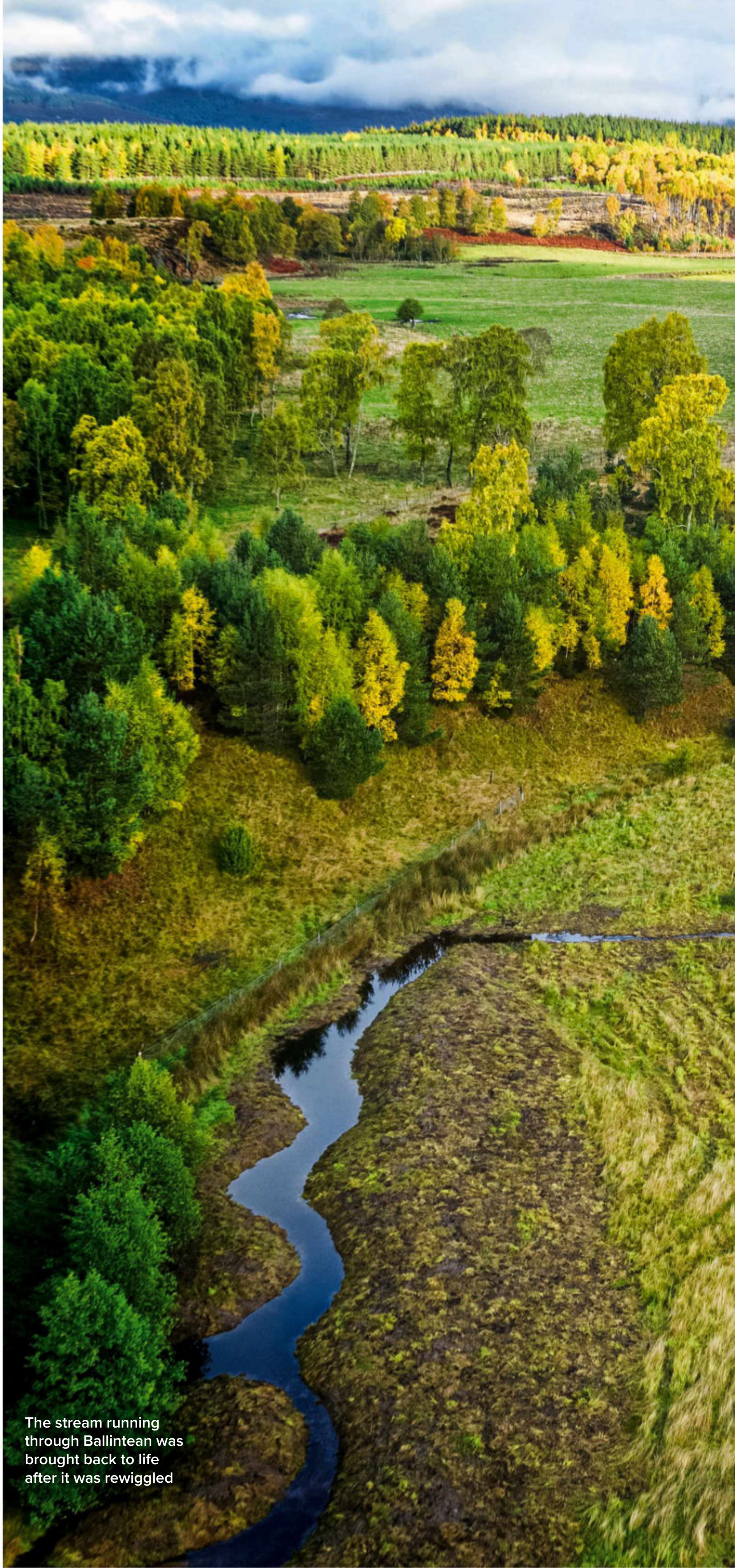
Over centuries, we’ve profoundly changed Scotland’s rivers – pacifying them and bringing them under our control. We’ve felled native woodlands to ‘tidy’ riverbanks, disconnected watercourses from their floodplains, and dredged and straightened river channels. For most people today, these simplified riverscapes are normal, and reflect their expectations of nature. As a society, we are blind to ecological loss and celebrate neat, orderly landscapes, where nature’s inherent dynamism is put in a box.

But things are changing. Responding to a free fall in wild salmon numbers, coupled with the growing frequency of major flood events, river scientists and land managers are increasingly embracing natural river processes. ‘Stage zero’ is a concept being applied to rivers and watercourses that have been straightened or otherwise modified. It recognises that rivers don’t naturally follow the linear channels we have allocated to them but, instead, want to weave across a loosely defined river-wetland corridor that features ever-shifting channels, wooded islands, backwaters and ponds. In time, a more dynamic and diverse mosaic of habitats develops, boosting biodiversity and retaining water at times of extreme high and low flows.

My first experience of this approach was at the Rottal Burn in Angus, one of the primary salmon spawning tributaries of the River South Esk, which flows through Glen Clova on its way to the Montrose Basin.

“The Rottal was straightened for drainage in the 1840s,” says Dee Ward, the landowner. Dee was a pioneer in restoring natural processes to a river for the benefit of the now-endangered Atlantic salmon. “Every time the burn flooded, young fish, eggs and gravel were just washed away,” he recalls.

In 2012, an 800m section of the burn was renaturalised by returning it to its original meandering channels – a process that is now fondly known as ‘rewiggling’. By increasing the length of this section to more than 1,200m, the flow of water was slowed significantly. The addition of woody debris in the form of windblown Scots pines, along with new tree planting alongside the burn,


The stream running through Ballintean was brought back to life after it was rewiggled

REWIGGLING A RIVER

Restoring rivers to more natural shapes has huge benefits for wildlife – as one project in the Cairngorms demonstrates

Words by **PETER CAIRNS** *Photos by* **SCOTLAND: THE BIG PICTURE**

Ospreys are specialised fish hunters and one of the many species to benefit from healthy freshwater ecosystems

meant that it quickly looked much wilder and, crucially, was no longer confined – free to weave its own pathways across the floodplain.

Craig MacIntyre, director of the Esk District Salmon Fishery Board, collaborated with Dee. "From a biological perspective, we're simply seeing more fish. The densities of salmon fry are five times what they were, and the complexity of the river gives salmon access to food and shelter at different stages of their life."

The Rottal provided an early blueprint for others to follow – and follow they have. A growing number of innovative restoration projects are now underway on rivers such as the Spey, Dee, Tweed, Aline, Laxford and Peffery. New 'riverwoods' are being planted, deadwood is being introduced into river channels (to mimic natural processes), and artificial barriers are being removed, returning rivers to their natural course.

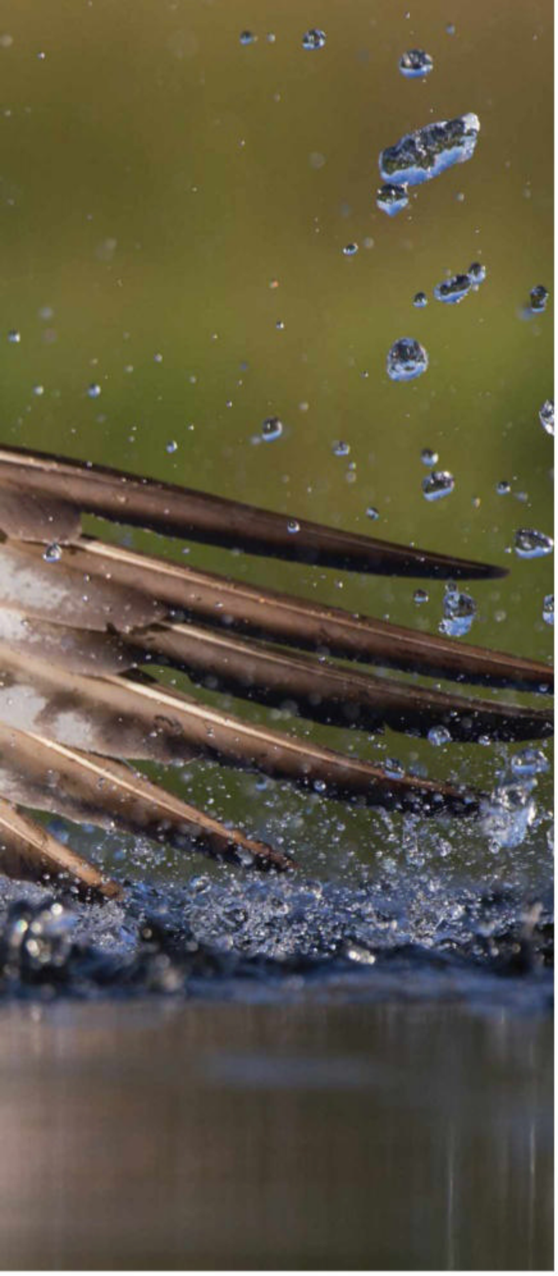
INTERESTINGLY, THESE PROJECTS ARE often driven by fishery bodies – organisations traditionally focused solely on salmon numbers for fishing. Many are now zooming out and recognising that the health of Scotland's rivers – and life within them – depends on the health of the landscapes through which they flow.

Ballintean, our 50ha farm in the Cairngorms, sits on the floodplain of the River Feshie, a hugely mobile river that constantly weaves back and forth across its wide channel, strewn with fallen trees. For the most part, the Feshie is relatively placid. But it has a volatile reputation, regularly transforming overnight into a raging torrent that floods the forest, cuts into its banks and deposits huge quantities of sand and shingle – islands that are quickly colonised by gorse and broom, followed by alders and willows. The Feshie is an unruly neighbour, flowing

ABOUT THE AUTHOR

Based in Scotland's Cairngorms National Park, Peter is a rewilding commentator, speaker and head of rewilding at Scotland: The Big Picture.

What had been a sterile drainage ditch at Ballintean was rewilded with new channels



In 2012, a section of the Rottal Burn was renaturalised to help protect Atlantic salmon

> “The River Feshie is an unruly neighbour, flowing as it wants to, but I embrace its free spirit”

as it wants to, as it needs to, like a petulant teenager. Its behaviour is unsettling for many, but I embrace its free spirit and feel privileged to witness the changes it catalyses.

We’ve been passively rewilding Ballintean for 30 years. Our governing principle throughout has been to let nature lead – allowing natural processes to shape a mosaic of regenerating native woodland, open grassland and the transitional habitats in between.

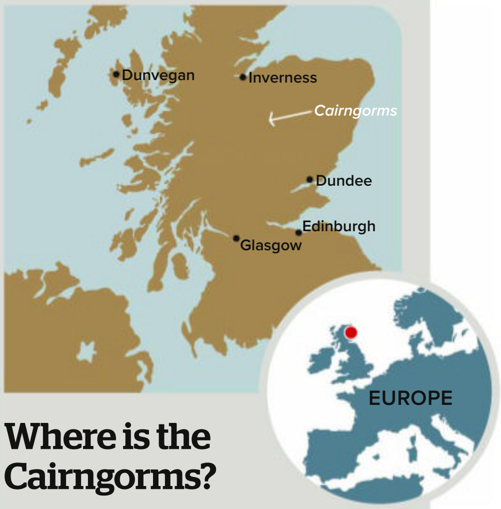
A peaty burn that was historically straightened runs through our ground. A few years ago, in a rare deviation from our hands-off approach, I began to wonder whether rewiggling this sterile drainage ditch, which channelled fast-flowing water to the Feshie, might bring it back to life.

Re-meandering a watercourse involves hardcore engineering but, with the relevant permissions in place, a young man called Jake turned up with his digger in the summer of 2022. Jake manoeuvred the machine back and forth with a deftness born from long hours reshaping other rivers and fragile peatlands. Such a heavy-handed intervention didn’t feel much like letting nature lead but my eyes were fixed on the prize. This was about short-term disruption to create a more ecologically complex, climate-resilient watercourse.

Jake crafted new bends and channels alongside the existing straight ditch. Once the water was released it would need to navigate a longer, more complex route, before finding its way to a series of scrapes and pools of varying size and gradient. After a couple of weeks, I watched him break the bund separating the old and new channels.

As the channels filled, I watched Jake’s face. He’d done this many times and on a much larger scale but, still, he beamed. It felt good to be providing work for a young local, while also making the case for rewilding as a valuable contributor to the rural economy.

Making more space for water is one of several key principles of the Northwoods Rewilding Network, a growing chain of nearly



Where is the Cairngorms?

Ballintean is in the Cairngorms which, at more than 4,500km², is the largest national park in the UK. The park covers parts of Aberdeenshire, Moray, Highland, Angus, and Perth and Kinross, and includes 46 Sites of Special Scientific Interest.

Female Atlantic salmon migrating up river to spawn

100 farms, estates and community landholdings across Scotland, all committed to nature recovery. Convened and operated by rewilding charity Scotland: The Big Picture, Northwoods is underpinned by a set of core rewilding principles that all land partners agree to adopt. Ballintean has been a Northwoods land partner since the network's inception in 2021.

Wetlands include river margins, marshes, reedbeds, bogs and ponds. All of these habitats are permanently – or at least frequently – waterlogged, and each supports its own community of wildlife. Just some of the Scottish species that depend on healthy freshwater ecosystems include otters, ospreys and freshwater pearl mussels. Moreover, wetlands provide us with clean water, moderate floods, maintain water flows during droughts, limit the spread of wildfires and store large amounts of carbon. Yet, despite their vital importance, the world's wetlands are being lost three times faster than our forests.

While our short stretch of rewiggling and rewetting in the Cairngorms may be insignificant on a global scale, even on a river catchment scale, it's a process that can be replicated. Since 2021, Northwoods land partners have created 300 new ponds and wetland features, planted 40,000 riparian trees and installed 100 'leaky dams' to replicate the work of beavers. Our project at Ballintean may seem humble but, scaled up across the network and beyond, it is part of real change that is not only possible, it's happening.

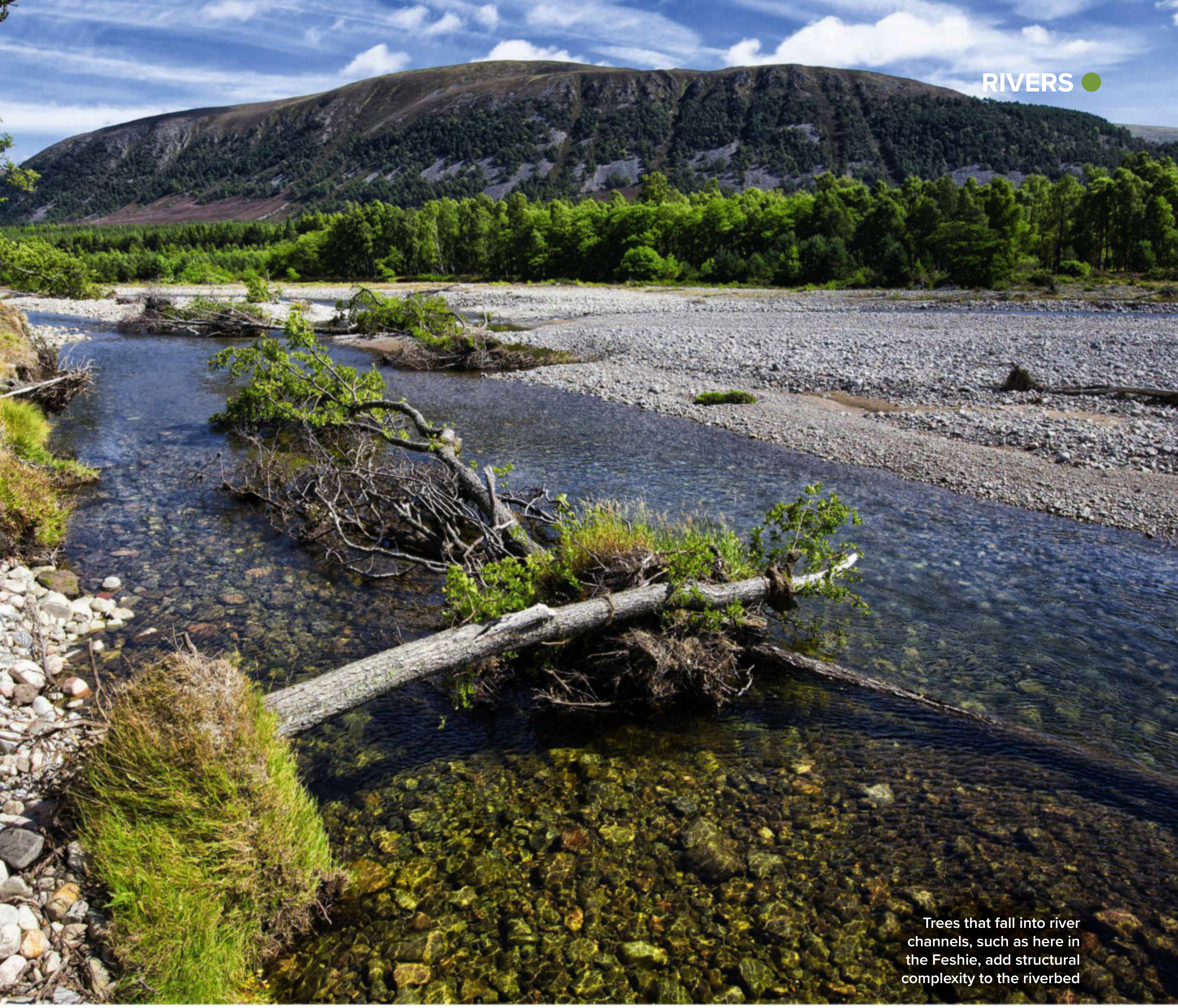
As Jake's digger was loaded on to a truck and disappeared into the distance, I turned to look at his work – we had a wetland. The diverted water followed its new wiggly course, with the overspill seeping out across boggy grassland, wetting areas that had been dry for decades. With exposed mud everywhere, it looked like a building site. But I knew that with a couple of years of regrowth, all signs of our intervention would vanish.

As I WANDER ALONGSIDE THE burn today, pond skaters flit across the water, frogspawn huddles in the pools and clusters of tiny alders peek out from the water margins. I notice a couple of young aspens that have suckered from a nearby parent tree, and think of the aspen-loving beavers that have recently been reintroduced into the Cairngorms. One day soon, I hope an adventurous beaver finds its way to Ballintean to enjoy nibbling its favourite trees. Venturing further, the distinct prints of a badger are etched in wet sand at the water's edge and, as I step closer, I disturb a pair of goldeneye ducks.

Further to the north, as the burn prepares to meet the Feshie, it runs through a more mature landscape. This is my favourite part of the farm, and provides a glimpse into what the rewiggled section could look like in a few decades.

Here, corridors of ageing alder trees mark the path of old river channels. Winter storms have brought down swathes of trees, which will be left to provide homes for redstarts and woodpeckers. Some alders and willows lie on the ground, some are suspended – snagged by other trees – while others have fallen into the river. Many are throwing up new shoots along their trunks,

Rewiggling helps to create the ponds and slow-moving streams needed by frogspawn



Trees that fall into river channels, such as here in the Feshie, add structural complexity to the riverbed

> “In allowing rivers to return to their natural selves, we’re inviting a richer version of nature into our landscapes”

adding further structural diversity. Our small herd of Highland cattle rubs on tree stumps, breaks through thickets of young birches, tramples fresh seed into the soft soil and fertilises the vegetation. And all the while, ribbons of water navigate their way through a constantly changing landscape. It’s all gloriously chaotic.

I’ve spent many years in Scotland’s rewilding space advocating for a reimagined relationship with wild nature. Much of the time, it has been slow progress. But every now and then, there’s a breakthrough. In recent years, the approach to river and wetland management has been nothing short of transformational.

Everyone wants to see the huge runs of Atlantic salmon returning each year from the sea and finding their way into the cool, tree-lined headwaters of Scotland’s rivers. On their way, they will routinely navigate multiple river channels, waterfalls, beaver dams and fallen trees – salmon never expect an easy journey. And perhaps that’s the lesson. Rivers, like salmon, aren’t designed for simplicity or control. They thrive on movement, complexity and unpredictability. In allowing rivers to return to their natural, messy selves, we’re not only giving wild salmon a better chance, we’re inviting a richer, more resilient version of nature back into our landscapes.

Rewiggling is an act of humility. It asks us to stand back, to let go of our compulsion to tidy and tame, and to trust that nature knows what it’s doing. The Feshie, the Rottal and the many other rivers now rediscovering their wiggle are templates for what’s possible when we work with nature, not against it. At a time when floods, droughts and biodiversity loss are on the rise, this shift in mindset is needed like never before.

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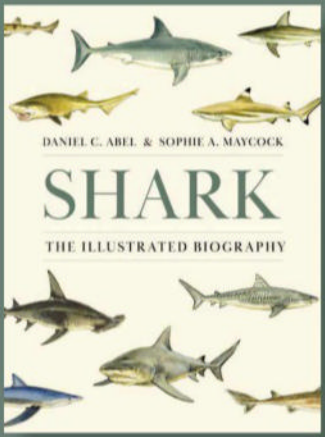
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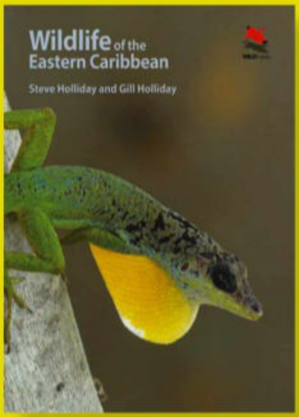
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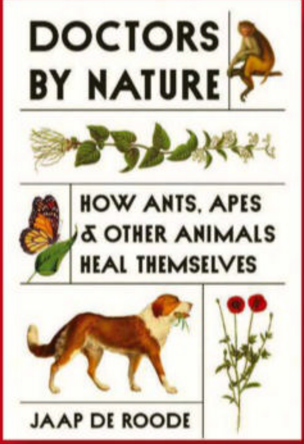
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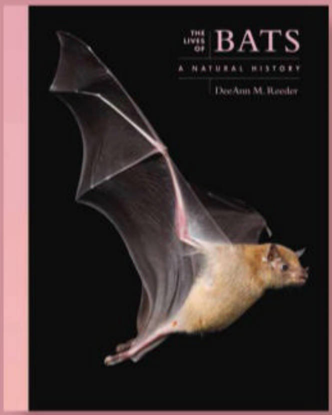
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Dolphins have been seen riding the bows of ships – known as bow-riding

DOLPHINS: VICKI SMITH/GETTY

Do any animals surf?

IN 2024, A CHOCOLATE LABRADOR FROM Brazil called Cacau won the World Dog Surfing Championships at Linda Mar beach in California. Watched by a crowd of thousands, she wowed the judges with her nimble turns in the unusually rough waters of the Pacific.

Cacau is just one in a long list of domestic animals taught to surf by their owners. Scour the internet and you'll find wave-riding cats, rats and goats – but if you want to witness a pro, look no further than marine mammals.

Bryde's whales have been filmed riding the waves off the east coast of Australia, where they use the momentum of the waves to help them feed on schools of fish. Fur seals have also been spotted surfing in the Table Mountain National Park Marine Protected Area in South Africa.

But the undisputed ruler of the waves – with surf action all over the globe – is the dolphin. Dolphins love to surface and have been spotted riding the crests of big waves as they roll into shore, as well as the bow waves of boats as they cut through the ocean. Individuals will often jostle for the best spot, and sometimes surf in large numbers. In 2023, a group of around 30 dolphins was spotted bow-riding a catamaran off the north-west coast of Wales. **Helen Pilcher**

ON THE MOVE
Why is the assisted migration conservation technique so controversial? **p76**

DINOSAUR DIE-OFF
What are the 'big five' mass extinctions and how have they affected life today? **p79**

FLYING FOXES
How did they get their unusual name – and why are they such brilliant flyers? **p84**

Sihek parents on Palmyra Atoll in the Pacific Ocean

What is assisted migration?

The Guam kingfisher – also known as the sihek – has been extinct in the wild since 1988 but was successfully introduced to Palmyra Atoll last year. However, they aren't native to the island (which is roughly one-third of the way between Hawaii and American Samoa). With the invasive brown tree snake responsible for their decline still at large on Guam, the most feasible way to restore them to the wild was by moving them to an entirely new home. Though the project is young, it's a high-profile example of a controversial conservation technique known as assisted migration.

> "Calculated risks are favourable to extinctions"

Assisted migration is the process of moving a species outside of its native range – usually because that range is too depleted for long-term survival as a result of climate change, fragmentation or invasive species. Occasionally, it's done to benefit the recipient ecosystem, such as the introduction of Aldabra giant tortoises to an islet off Mauritius to manage plant populations after the Mauritius giant tortoise became extinct.

For some conservationists, the reluctance to suggest assisted migration is automatic. It's considered by some to be "the ultimate meddling", says Sarah Dalrymple, a member of the England Species Reintroduction Taskforce. But she points out that "humans have been moving things for millennia". As habitat and climate crises worsen, she believes migration can be vital for the right species and it's our "ethical responsibility to explore all options".

The method will always confer risk, however. Despite conservationists working with robust assessments, some believe the threats associated with invasion, including resource scarcity and disease transmission, are too unpredictable. Introducing the American red squirrel to Newfoundland, for example, may have diminished native red crossbill populations because of greater food competition.

Donal Smith of Monash University, Australia, agrees that "there's a level of certainty we may demand but never get" when ensuring assisted migration is as low risk as possible. But for species where other strategies have been exhausted or are non-starters, he maintains that calculated risks are favourable to extinctions. This has happened before: it was considered too late for ex situ care to be appropriate for the Christmas Island pipistrelle, a small Australian bat that ultimately went extinct in 2009. This question of risk has been self-perpetuating: as there have been so few well-documented outcomes, there is a lack of strong evidence of assisted migration's long-term impacts. In turn, this knowledge gap makes it even harder for scientists to take the risk when needed.

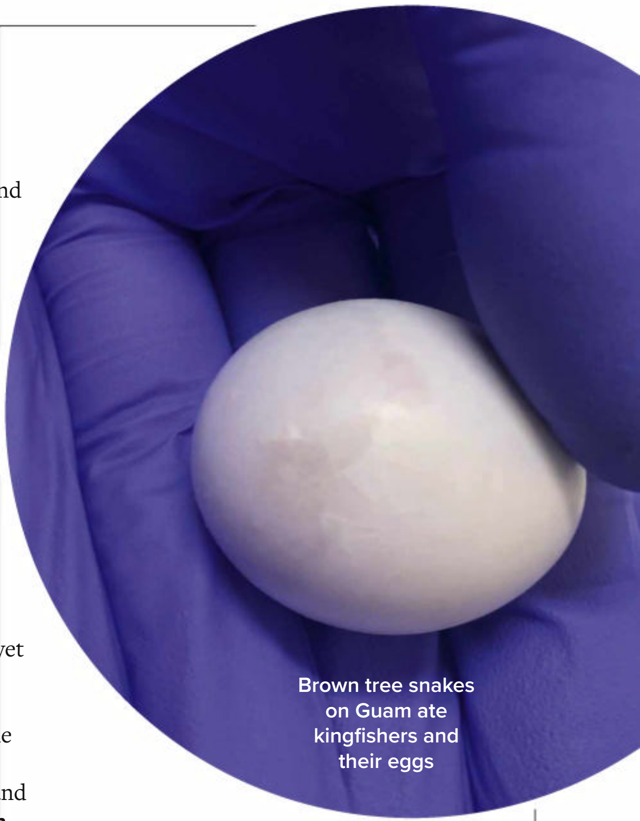
Even if it's decided to be the best approach, assisted migration faces a number of socio-political hurdles too. Funding is a major concern and partial cause for the knowledge gap. It's a massive commitment to study the multi-generational outcomes of both the species and ecosystems and requires backing that's not always available in conservation. There is also the question of who foots the bill if something goes wrong.

Equally, there's little policy or law dealing with assisted migration, and those invested in local land, such as farmers and residents, are often justifiably concerned about its impact.

Attitudes are slowly shifting though and Dalrymple has recently been contracted to write an assisted migration framework for Natural England. This high-profile acknowledgement of the strategy signals that it's time to consider all options.

> "Who foots the bill if something goes wrong?"

Although it won't be right for many species, the reality is "people are doing translocations with quite innocuous things all the time", according to Dalrymple. Most assisted migrations happen just tens of miles outside of the indigenous range and often with plant or invertebrate species people don't notice, yet are essential to thriving ecosystems. With careful conversation and comprehensive policy, assisted migration could change the game for wildlife, as it has for the Florida torreya tree and western swamp turtle – and now the Guam kingfisher. **Annaliese Smith**



Brown tree snakes on Guam ate kingfishers and their eggs

The ZSL Institute of Zoology is working to establish a healthy population of the Guam kingfisher

KINGFISHERS IN TREE: MARTIN KASTNER/TNC-ZSL; WING: THOMAS MANGLONA/KUAM; EGG: ZSL

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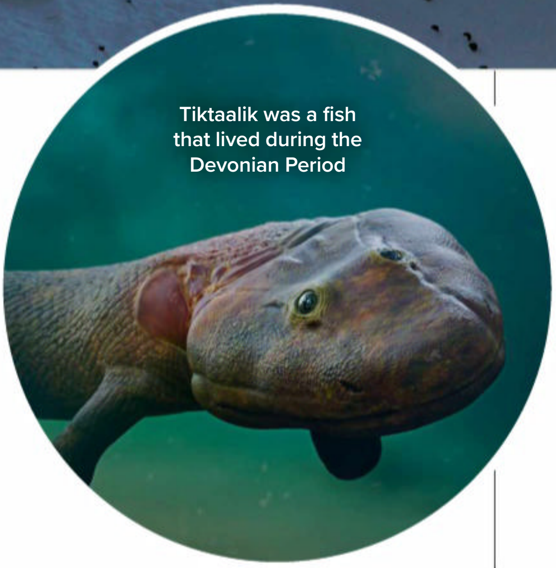
Entire species were wiped out almost overnight in the last extinction event

How many mass extinctions have there been?



Tiktaalik was a fish that lived during the Devonian Period

MASS EXTINCTIONS ARE A WIDESPREAD and rapid loss of life on Earth, typically in response to some kind of global catastrophe or change in climate. These events have occurred throughout Earth's history and have played pivotal roles in shaping both its past and current biodiversity.

While they may be best known for destroying life, mass extinctions also promote the evolution of new species, levelling the playing field for groups who, prior to a mass extinction, may have lived in the shadows of more dominant species. Take mammals, for example – they prospered and rapidly diversified after non-avian dinosaurs were wiped out 66 million years ago. There have been five major mass extinction events. Together, these events are known as the 'big five'.

The Late Ordovician mass extinction, which took place 445 million years ago (MYA), wiped out 85 per cent of all species. It was the second most destructive event of the 'big five' and, unlike the others, may have been triggered by global cooling.

The Late Devonian mass extinction (372–359 MYA) was a drawn-out event that annihilated coral reefs and diverse groups of fish. As much as 70 per cent of all species faced extinction at this time, likely in response to ocean anoxia – a total lack of oxygen.

> **"The 'great dying' erased 90 per cent of all species"**

Next was the End Permian mass extinction (252 MYA) which is best known as the 'great dying' – a fitting nickname considering it wiped out 90 per cent of all species. This calamitous event was triggered by the eruption of a huge volcanic system that once lay under what is now Siberia, Russia.

The Triassic-Jurassic mass extinction (201 MYA) was caused by global warming and killed off 75 per cent of all species, including the non-dinosaurian archosaurs. After they disappeared, dinosaurs took their place and established their long-lasting terrestrial dynasty.

This was, of course, toppled during the last of the 'big five': the End Cretaceous mass extinction (66 MYA). This was triggered by an asteroid impact and, unlike previous extinctions, erased entire groups of animals and plants almost overnight.

These are just five of the most destructive mass extinction events – according to some estimates, there may have been as many as 20 in the last 540 million years. There's also growing evidence to suggest that we may be undergoing a sixth mass extinction, as a result of human-induced global warming, making our 'big five' a 'big six' in the future. **Will Newton**

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Is horseshoe crab blood really blue?

Beyond their odd appearance and ancient history, there is another thing that makes horseshoe crabs stand out from the crowd: their bright blue blood.

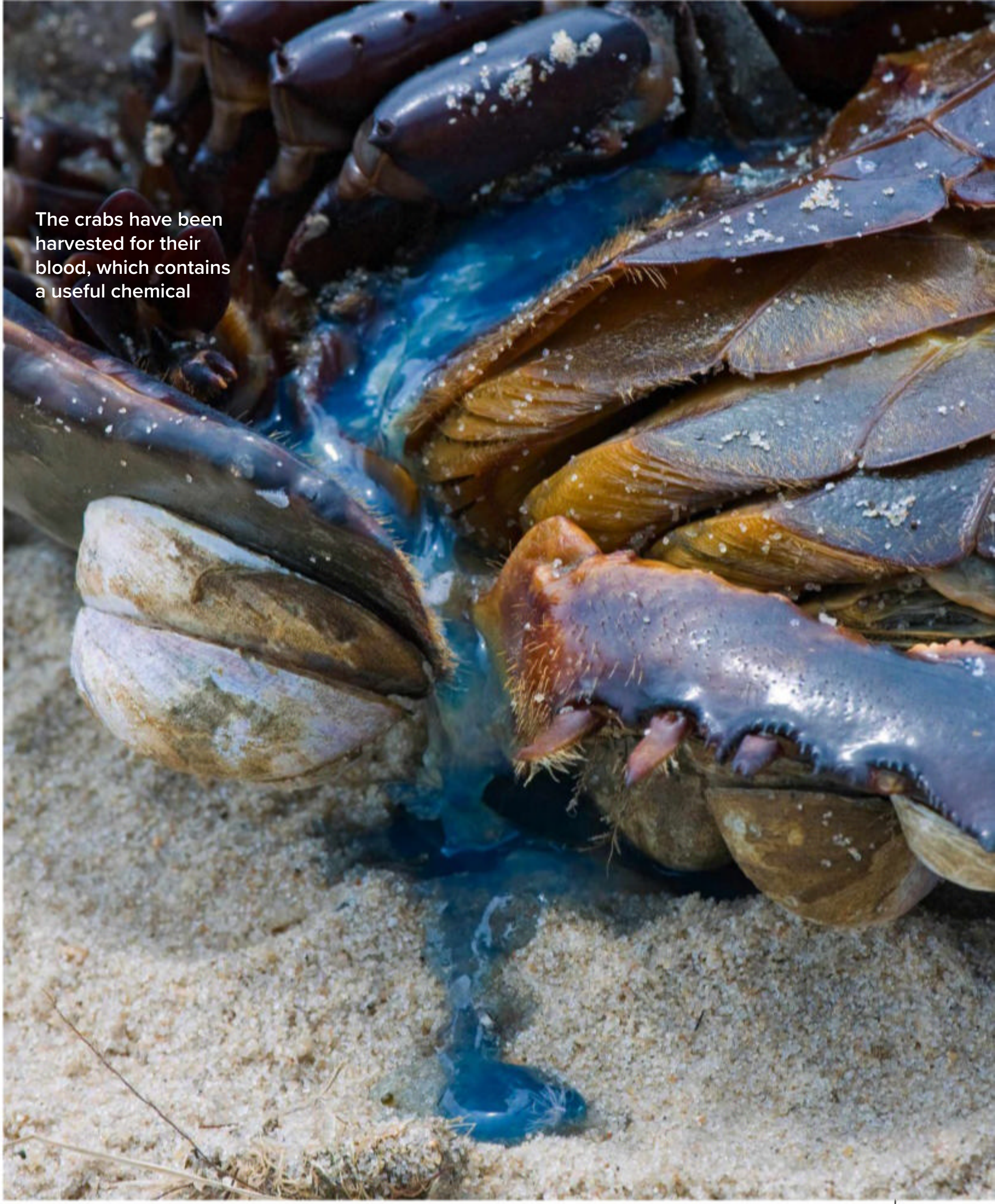
The blue colour is caused by the protein haemocyanin, which is their equivalent of haemoglobin (the molecule that carries oxygen in human blood). Rather than being iron-based, as haemoglobin is, haemocyanin is copper-based.

When the blood is oxygenated, the copper means it takes on a blue appearance – but little or no colour when it's not exposed to oxygen.

Horseshoe crabs aren't the only animals with blue blood. Molluscs including octopuses, squids and snails, and arthropods such as scorpions, lobsters and crabs are blue-blooded for the same reason.

But there's something else special about horseshoe crab blood: it contains cells that clot in the presence of toxic bacteria. A protein extracted from these cells is used to check that vaccines aren't contaminated, meaning that horseshoe crabs have likely saved millions of humans from illness.

A synthetic molecule that does the same job was created by researchers in the late 1990s and is now starting to take over these vaccine safety tests. **Beki Hooper**



The crabs have been harvested for their blood, which contains a useful chemical

Horseshoe crabs are found along the coasts of North America and east Asia

CRABS ALONG SHORE: SEAN CRANE/MINDEN/NATUREPL.COM; BLUE BLOOD: PIOTR NASKRECKI/MINDEN PICTURES/ALAMY

Waterways are used as transport links by indigenous people who live in rainforests

What happens to rainforests if there's no rain?

The heavy rainfall that powers rainforests is caused by the complex interaction of multiple geographic and climatic factors, including mountain ranges, ocean and wind currents, and the intensity of solar exposure. The forests themselves contribute to rainfall, with evaporation from plant biomass contributing significantly to the water cycle.

Disruptions to any of these factors can lead to drought – altering the delicate balance that sustains them. Periodic droughts are normal in rainforests but they regenerate in short order once the rains return. However, they are increasingly stressed by decreased rainfall resulting from climate change and deforestation.

When the rain doesn't come, a cascade of harmful effects ensues. Trees become stressed and close their stomata – pores in their leaves that facilitate gas exchange – thus reducing intake of carbon dioxide and release of water vapour and oxygen. Eventually, they may shed their leaves. Hot, dry conditions can result in the rupture of the xylem cells that conduct water and ultimately kill the tree. Understory plants that rely on shade from the taller trees perish, too.

> "Rainforests regenerate rapidly once rain returns"

When trees become stressed and die, the forests become more susceptible to wildfires. Fires may occur naturally due to lightning strikes but some are set intentionally by humans in order to clear space for agriculture. After the fires subside, invasive plant species can take hold, reducing the chances that the forest will rebound.

Decreased leaf cover and fruit production affect the animals reliant on these resources. They may be forced to migrate to more abundant regions, creating competition with other animals, or simply starve. Smaller animals that need regular access to water will die because they are unable to move over long distances.

The bodies of water that thread through rainforests reduce in volume or disappear entirely. This can lead to large-scale death of fish and other aquatic organisms – the Amazon drought has killed hundreds of river dolphins due to overheating.

Indigenous people who make their livelihoods from the rainforest may face extreme privation as well. In some cases, they cannot even leave due to the reduction of the waterways they rely on for transport.

Rainforest droughts also have worldwide implications: these forests are some of the world's largest carbon sinks, holding millions of metric tonnes of carbon. These forests are crucial to the global ecological balance. **Richard Pallardy**

RAINFOREST WATERWAY: ADRIAN DAVIES/NATUREPL.COM

Do any animals get malaria?

Malaria is the number one killer in human populations in tropical and subtropical countries where the *Anopheles* group of mosquitoes is found.

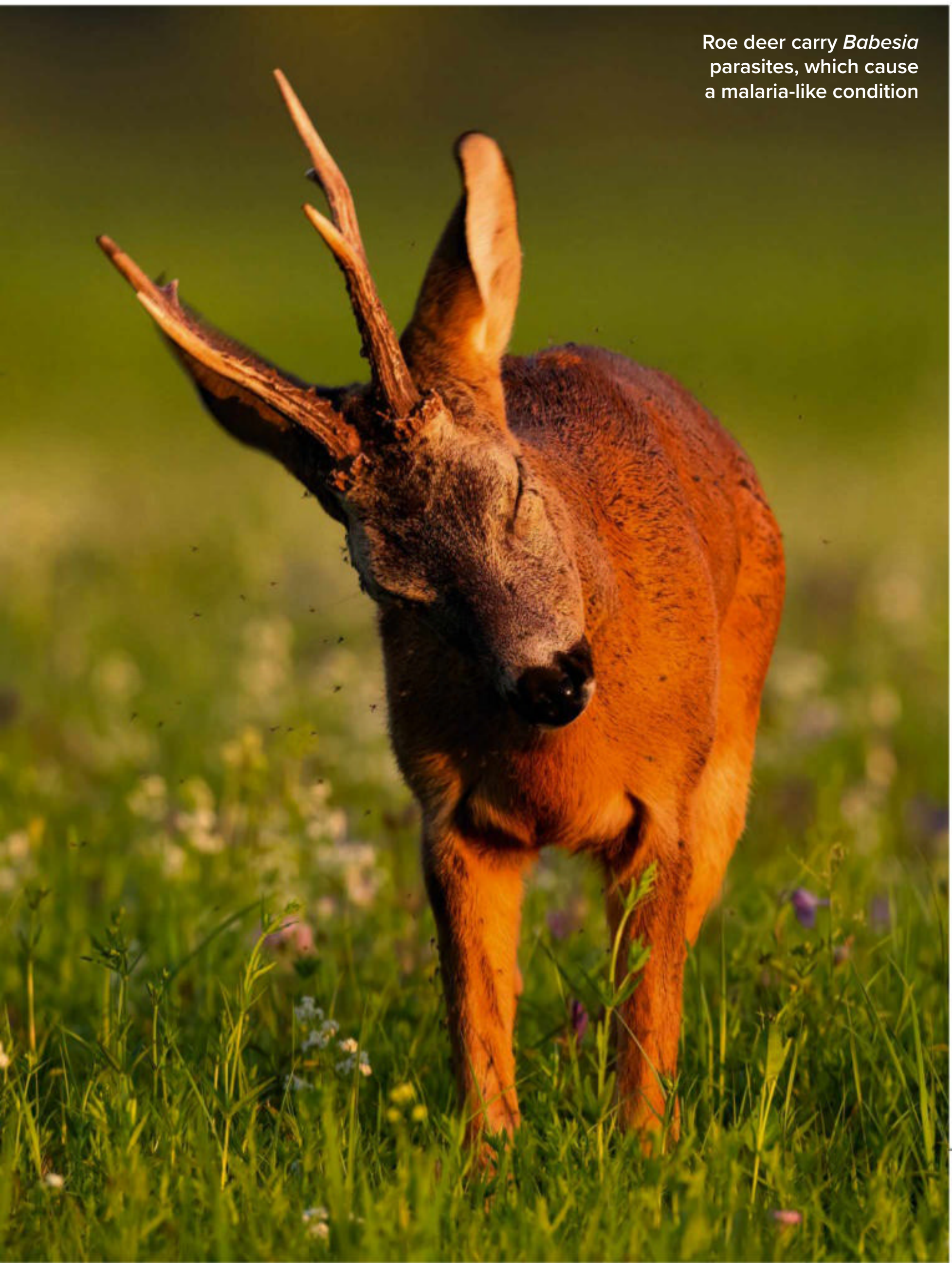
The disease is caused by the *Plasmodium* parasite that grows within the female *Anopheles* mosquito and then passes to her prey in her saliva when she ingests the blood necessary to trigger the development of eggs.

There are hundreds of species and subspecies of *Anopheles* mosquitoes but only 55 of these are known to infect people with malaria. There are more than 200 species of *Plasmodium* parasites, but only five of these are dangerous to humans. As mosquitoes also feed on a variety of mammals, birds and reptiles, even if they do favour human blood, it stands to reason the rest of the *Anopheles* group, and the remaining 195 parasite species, must be capable of causing malaria in non-human animals.

Indeed, scientists working on malaria cures have long known this fact and have tested their treatments on infected monkeys, rodents and birds. And farmers and vets have routinely found malaria in livestock, wild birds and domestic pets.

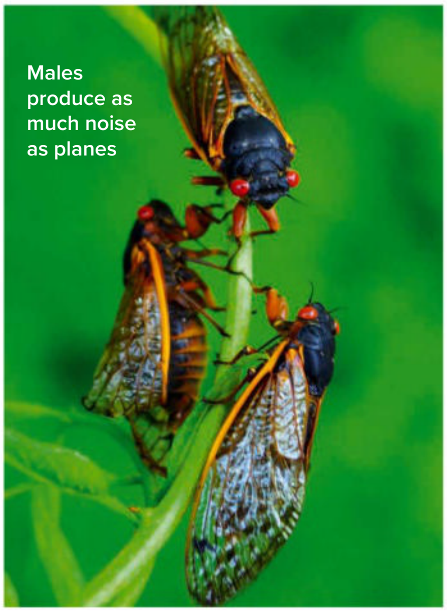
In non-humans, symptoms can be similar to those experienced by people – high temperature, lethargy, loss of appetite, jaundice and difficulty breathing. Birds show weight loss, ruffled feathers and drooping heads. In all cases, malaria infection is confirmed by a blood test.

Sheena Harvey



Roe deer carry *Babesia* parasites, which cause a malaria-like condition

How are cicadas so loud?



Males produce as much noise as planes

Cicadas are known for their loud calls. When thousands of them are in the mood for love, the sound can be deafening.

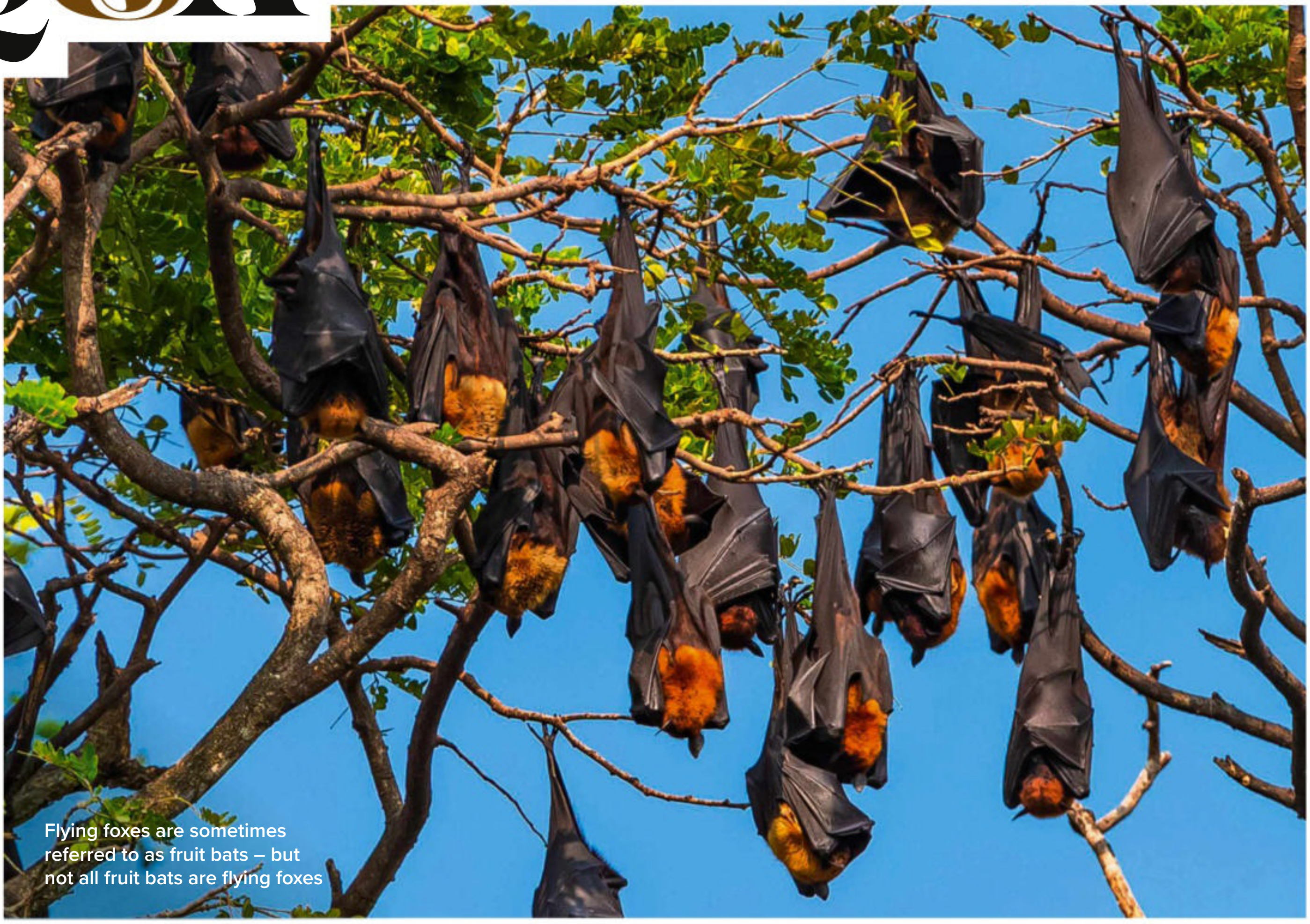
Male cicadas produce this cacophony in order to attract mates using a pair of organs called tymbals. Located beneath their wings, tymbals have two main components: a series of ribs made of chitin (a polysaccharide that is the main component of insect exoskeletons), and a membrane made of the rubbery, flexible protein resilin. Using muscles on either side of the tymbal, the cicada contracts the organ, buckling the ribs. The contraction and release of the ribs creates a series of sounds – sometimes as many as 400 in a single second. This registers as a buzz to the human ear.

These sounds are further amplified by their tracheae (which they use to exchange oxygen and carbon dioxide) and by their hollow abdomens, which serve as resonance chambers. The songs can reach intensities of up to 120dB in some species.

The tymbals are not the only organs cicadas use to produce sound – they may also flick their wings or stroke them against specialised structures in an action called stridulation.

Richard Pallardy

MOSQUITOES: JMROCEK/GETTY; CICADAS: ENIGMA/ALAMY



Flying foxes are sometimes referred to as fruit bats – but not all fruit bats are flying foxes

ALL YOU EVER NEEDED TO KNOW ABOUT

Flying foxes

BY JO PRICE

FLYING FOXES ARE BIG TROPICAL BATS that tend to roost in large numbers and mainly feed on fruit, pollen and nectar. They play a crucial ecological role as pollinators (when they eat, pollen sticks to their fur) and seed dispersers (via excretion), and are responsible for maintaining high plant diversity in the primary forest habitats that they live in.

Why are they called flying foxes?

They have heads that resemble a fox, with pointed ears and large eyes. They belong to the genus *Pteropus* (considered to be 'true' flying foxes), which is part of the megabat family Pteropodidae. *Pteropus* means 'winged foot', from the Greek words *pteron* (winged) and *pus* (foot). *Acerodon* species are also often referred to as flying foxes and are part of the Pteropodidae family.

Where do they live?

More than 60 species of flying fox are recognised, and they are found in tropical and subtropical regions of Asia, and islands in the Pacific and Indian oceans.

How big are flying foxes?

According to Guinness World Records, flying foxes are the largest bats in the world: "The biggest are generally considered to be the Indian flying fox (*Pteropus giganteus*) and the giant golden-crowned flying fox (*Acerodon jubatus*)." Several species in the genera *Pteropus* and *Acerodon* have a head-body length of up to 45cm, a wingspan of 1.7m and a weight of 1.6kg.

Why do they need large wings?

The huge wings of flying foxes enable them to fly far in search of food. They are long and narrow to reduce drag and allow for efficient gliding. And being bigger, they beat slowly and powerfully to conserve energy. The wings also help with manoeuvring, thanks to flexible membranes that can manipulate air flow to control flight direction and speed. The large wing surface area also aids lift – handy when weaving through trees and landing on branches.

How do they cope with the climate?

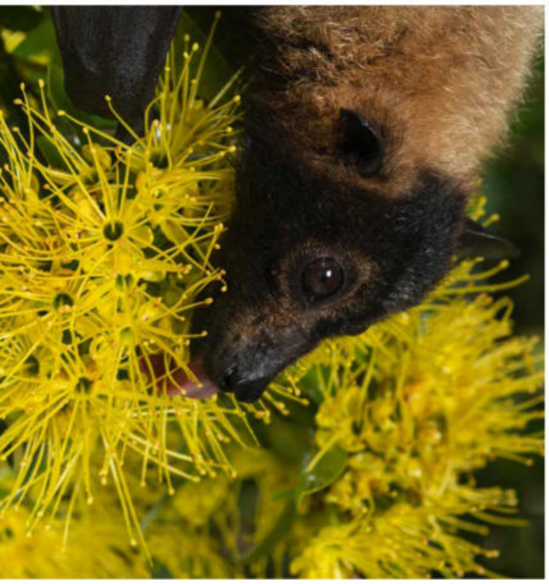
Flying fox wings are full of blood vessels, which help regulate temperature. When it's cool, a flying fox will wrap its wings tightly around its body like a blanket, trapping heat. In hot weather, the mammal spreads its wings to release heat and fans itself.

How else do they keep cool?

In the BBC natural history series *Wonders of the Monsoon*, little red flying foxes (*Pteropus scapulatus*) were filmed skimming the surface of a river mid-flight to soak their chests – avoiding opportunistic crocodiles.

What other adaptations do they have?

These mammals have clawed feet, which allow them to grip branches and hang upside down for long periods. They also have clawed thumbs to pull fruit or flower-laden branches towards them.



A female flying fox carrying a pup

Top: A spectacled flying fox feeds on nectar from a golden penda in Queensland, Australia
Above: Taking a belly dip to cool off

How do they feed?

Flying foxes do not use echolocation, relying instead on their sense of smell and excellent vision. Most species are nocturnal and can cover up to 30km in one night while foraging. They dip their heads into flowering plants and use their long tongues to extract pollen and nectar. When feeding on fruit, they compress the fruit in their mouths to squeeze out and consume the juices – the rest they spit out.

Where do they roost?

They like roosting in large trees with open canopies for easy take-off and landing, and near water to keep cool and hydrated. Some species roost in urban areas for year-round food availability and fewer natural predators (birds of prey and large reptiles). A roosting colony is known as a camp and can contain tens of thousands of bats (depending on food availability and breeding season).

When does mating season occur?

It varies by species and location but births are usually timed to coincide with food availability, such as flowering or fruiting periods, which increases the chances of survival for offspring.

How do they breed?

Most flying fox species are polygynous, with males mating with multiple females. During the breeding season, males establish territories and guard harems of females. A *Biology Letters* study found that grey-headed flying fox males with higher testosterone levels were more successful at maintaining their harems in the mating period.

How do females care for their young?

Gestation lasts about five to six months and females tend to give birth to one pup a year. Young are born covered in fur with closed eyes and are carried by their mothers for several weeks (including in flight), clinging on with their feet, thumbs and teeth. Weaning starts at around three to six months, depending on the species.

Do they face any threats?

The main threats are habitat loss, climate change and extreme weather (heatwaves, for example), and disturbance of roosting sites (particularly small island populations). The bats are also hunted and culled, both for bushmeat and because they are thought to be crop pests in some places. The conservation status of flying foxes varies depending on the species but an estimated 17 species are classed as Critically Endangered or Endangered.

A FLYING FOX'S SPECIAL FEATURES

AT A GLANCE

Scientific family name: Pteropodidae

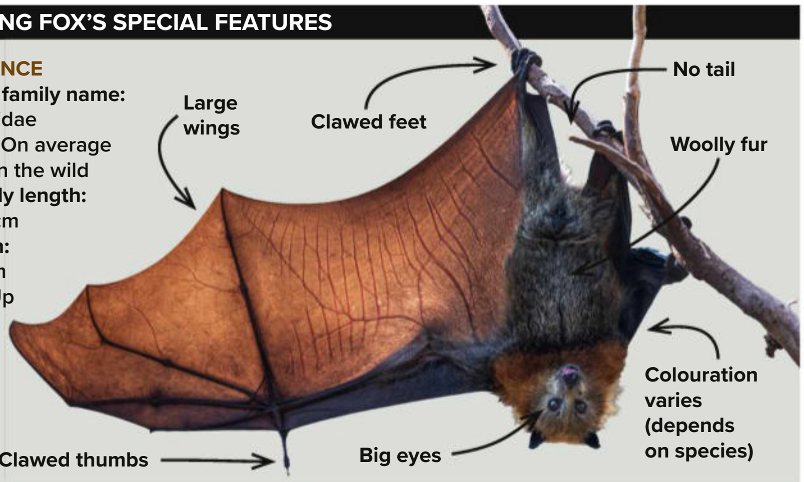
Lifespan: On average 15 years in the wild

Head-body length: Up to 45cm

Wingspan: Up to 1.7m

Weight: Up to 1.6kg

Speed: Maximum 30.6kph

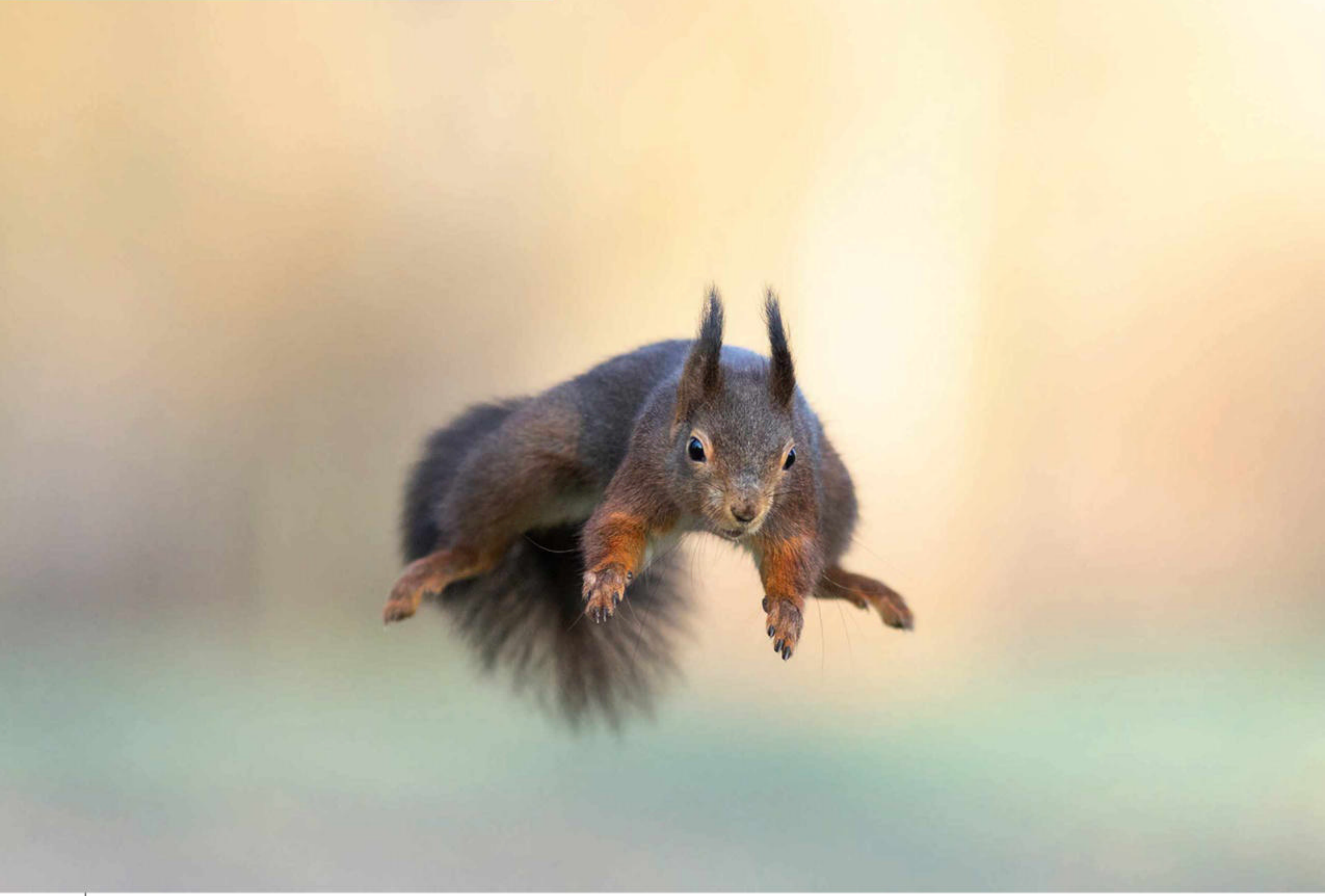


NEXT MONTH

BULLET ANT

Territorial venomous insect

BAT ROOST: MARIUS DOBILAS/ALAMY; FEEDING: JUERGEN FREUND/NATUREPL.COM; BELLY DIP, FLYING WITH PUP AND CUTOUT: DOUG GIMESY/NATUREPL.COM; BULLET ANT: IMAGEBROKER.COM/ALAMY

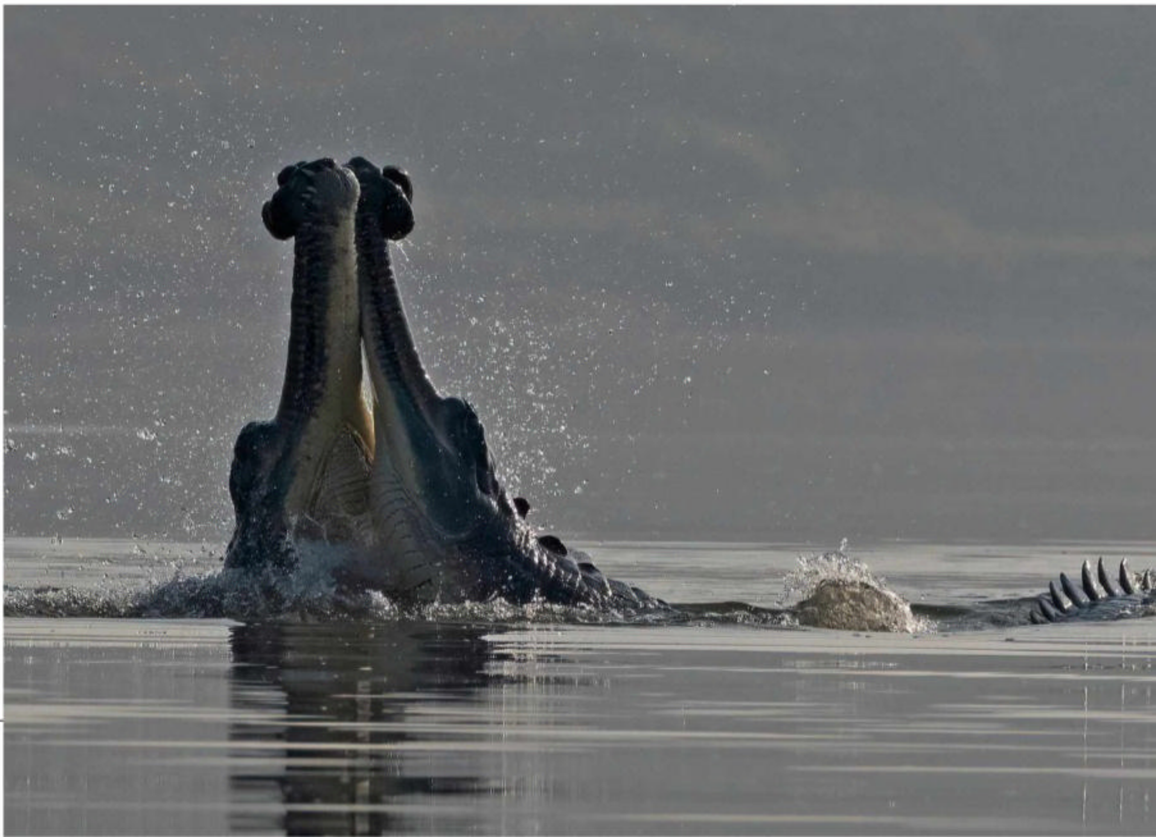


Leap of faith

To get this shot, I built a feeding station in my friends' garden that red squirrels could reach by jumping. I like the determined expression on this individual's face. Red squirrels are amazing – I love watching them.
Nathalie Serieys, Chédigny, Loire Valley, France

Snout joust

During breeding season, two male gharials fight for dominance in the Chambal region of India. They make hissing sounds, climb on each other's backs, and use their long, bulbous snouts to tackle and beat each other.
Viraj Athalye, Ratnagiri, India



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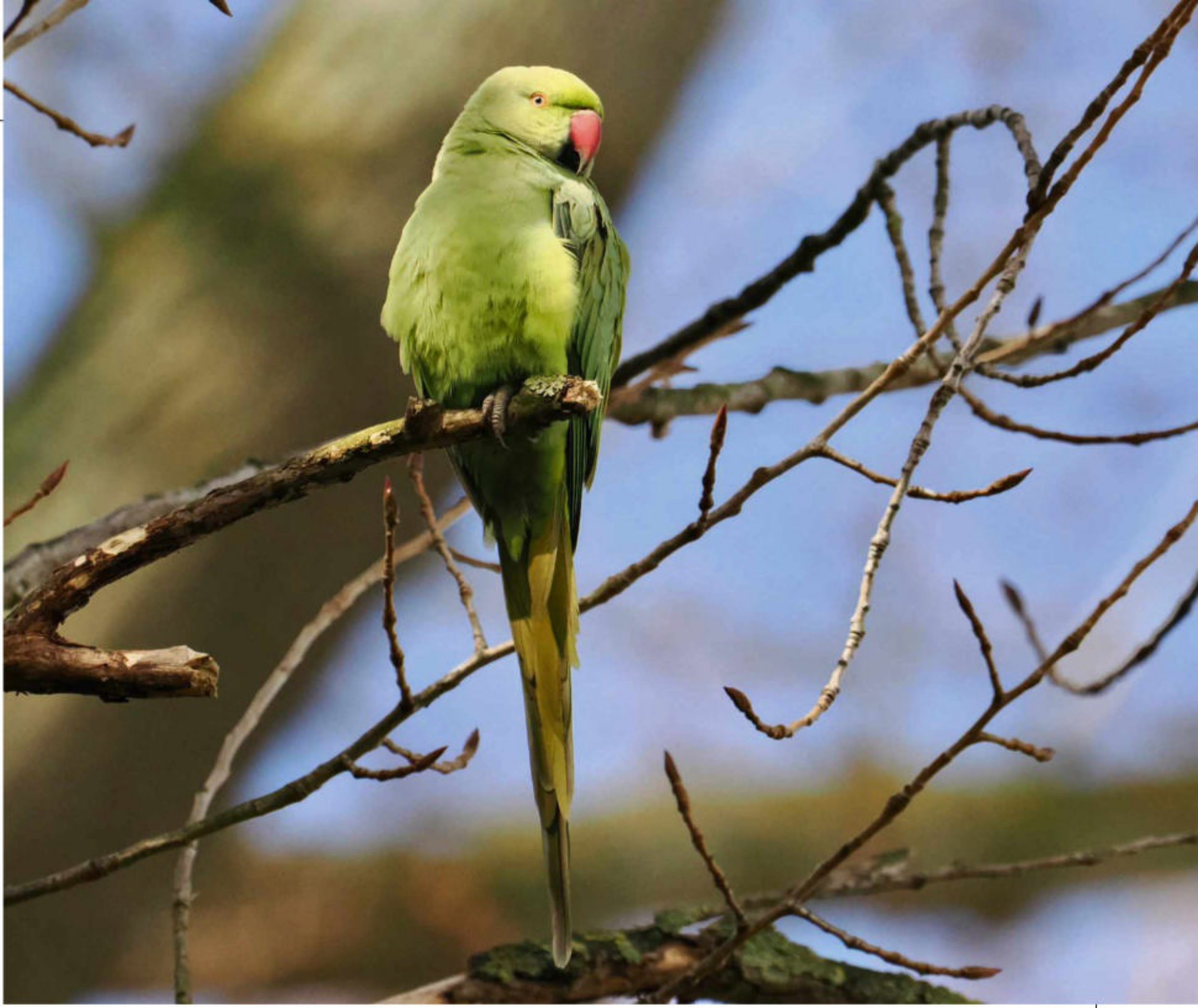
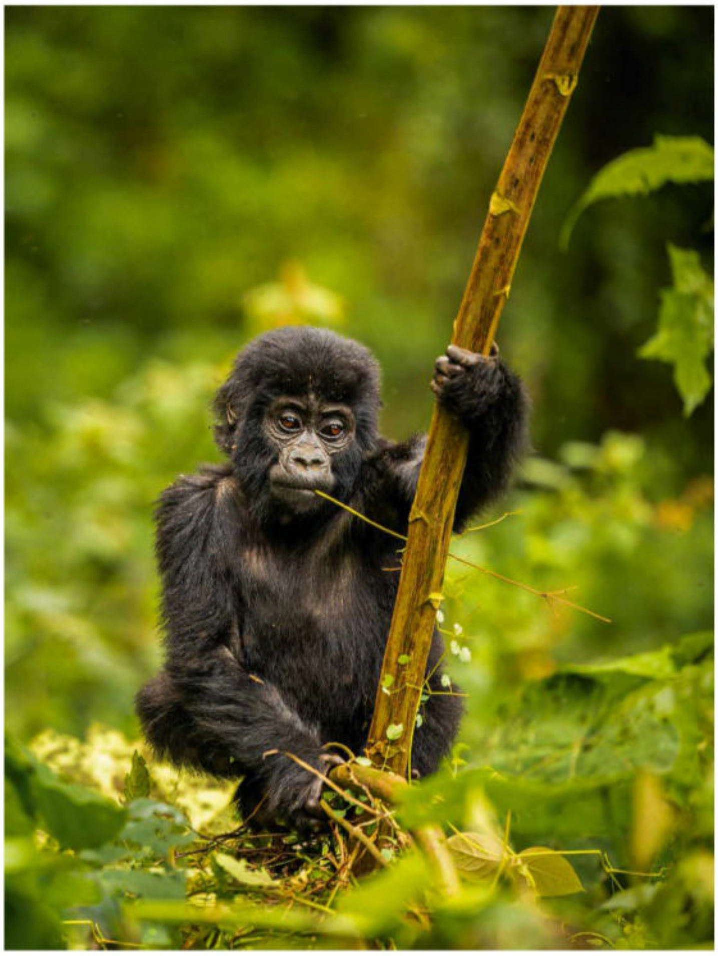


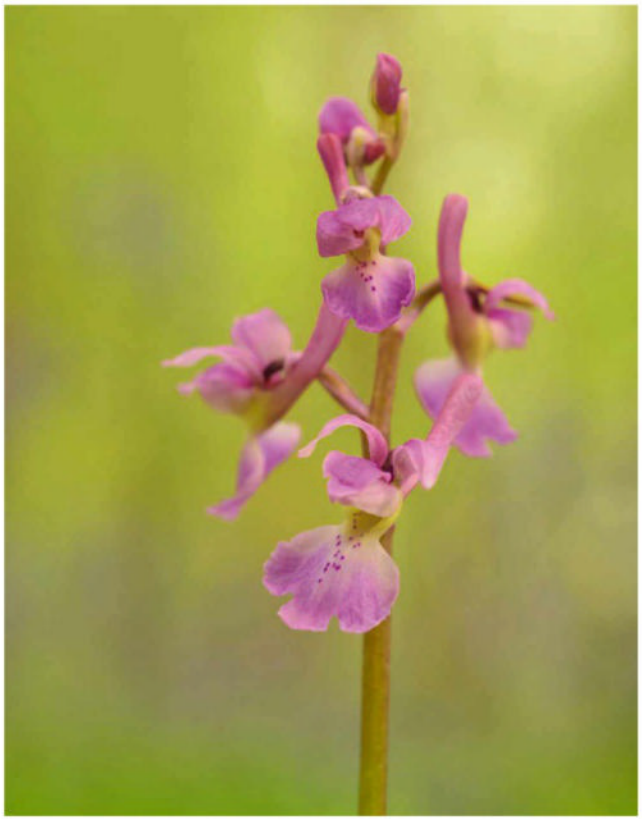
Exotic escapee

I never knew ring-necked parakeets resided in Suffolk so it felt surreal to see them. It's the UK's only naturalised parrot.
Carly Culmstock, Bury St Edmunds

A little reward

After hours in Bwindi Impenetrable National Park in Uganda tracking a mountain gorilla family with rangers, this little guy popped up just before the heavens opened and the gorillas all scattered.
Charlotte Keast, London

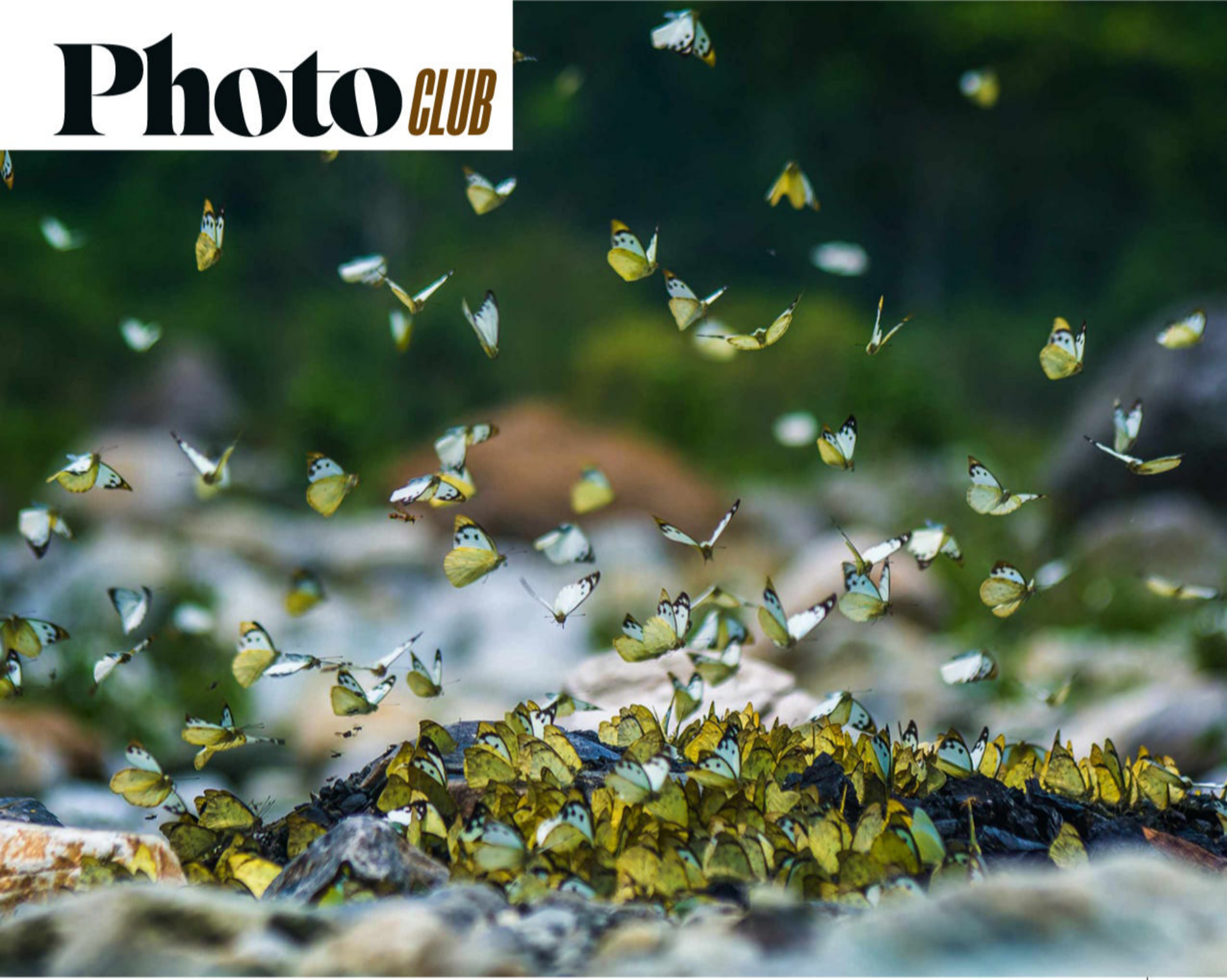


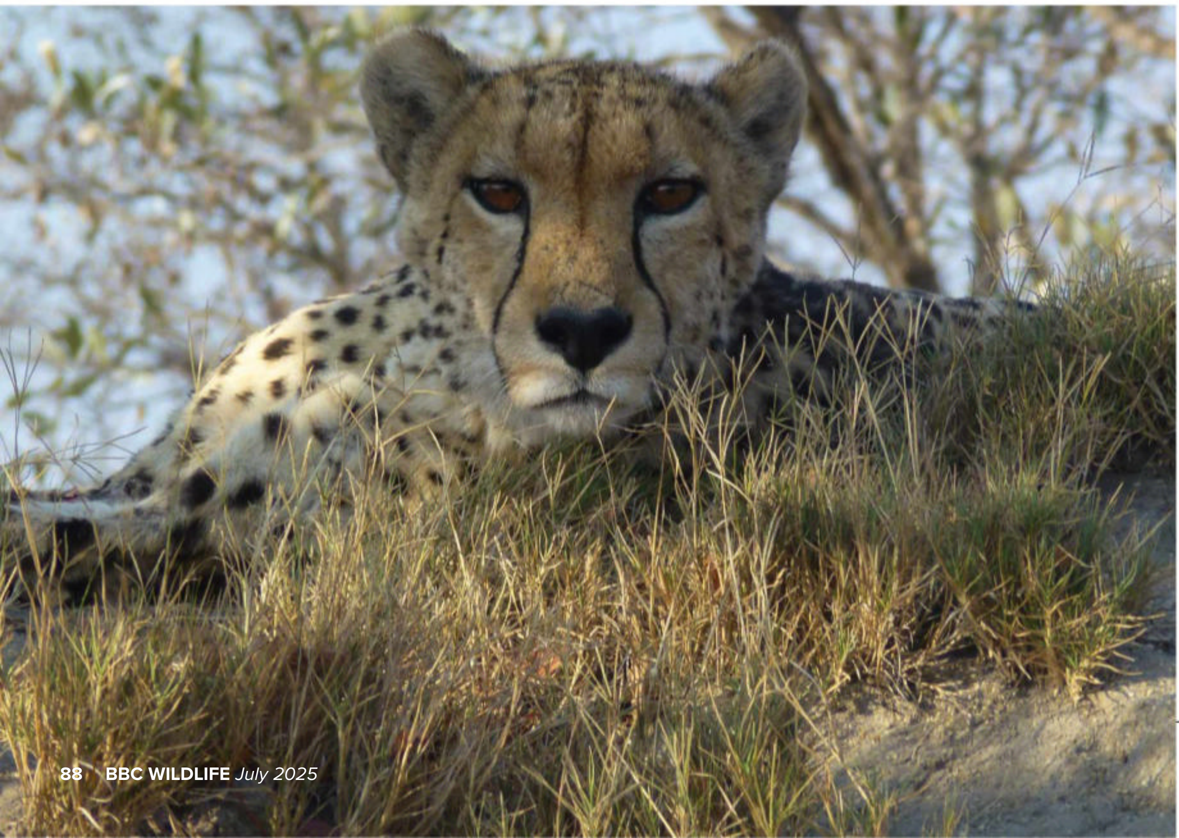


Early bloomer

This striking early purple orchid was captured in ash woodland in Hampshire during spring, where it flourishes alongside bluebells.
Mike Blacknell, Bishopstoke, Hampshire

Photo CLUB





Puddling party

A flutter of plain puffin butterflies congregates in the Jayanti riverbed in Buxa Tiger Reserve, West Bengal, for some summer mud-puddling. The insects imbibe essential nutrients from the wet mud.
Shamik Sanyal, Jalpaiguri, India

Taking it slow

As the cheetah is the fastest land animal on Earth and Africa's most endangered cat, it was quite the reward after a long trek to see this one having some quiet time in Ulusaba reserve, South Africa.
Anne Wood, Maidenhead, Berkshire

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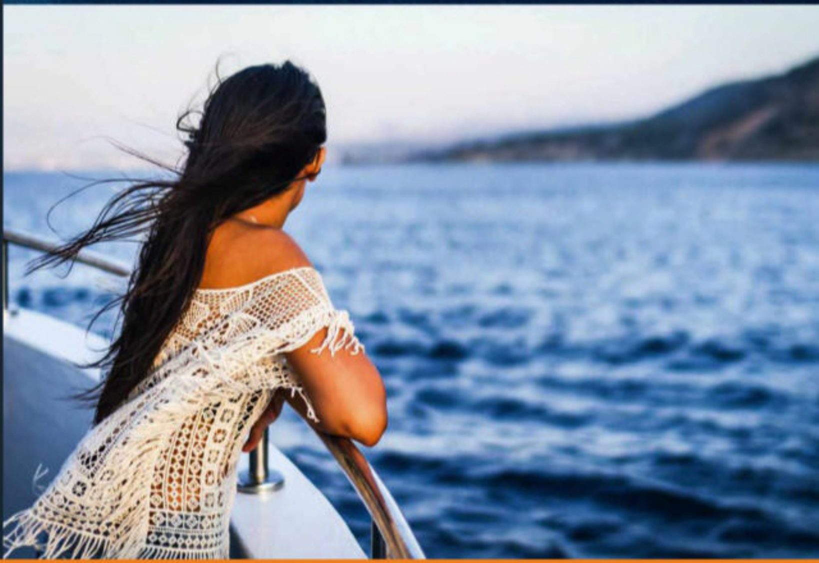

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Photographing a Nile crocodile in Botswana

SNAP-CHAT

THE INSIDE WORLD OF WILDLIFE PHOTOGRAPHY

Bella Falk on wild dogs, torrential rain and a grumpy elephant

How did you get into wildlife photography?

It started with a love of travel photography but I'm not really into cities or beaches – I prefer being away from the crowds, in nature, where animals tend to hang out. I found them more exciting and rewarding to photograph than landscapes or architecture. I visited the Galápagos, Antarctica and Tanzania, and I was hooked.

Which of your shots is most important to you, and why?

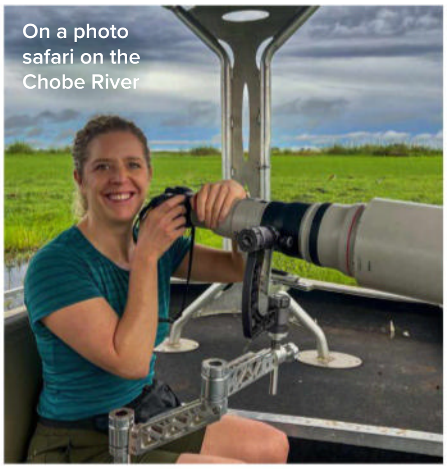
In Kibale Forest, Uganda, I photographed a chimpanzee posing beautifully on a log in perfect light. It was one of my first wildlife photos to be published and has since become my most stolen image. Just about every chimpanzee trekking operator in Uganda has it on their website. It still makes me quite ragey but I've learned not to look now!

What's been your most memorable encounter with a wild animal?

Tsavo, in Kenya, goes through long periods of drought, so the team at Kipalo Hills fills waterholes for the animals. I was taken to watch the ranger turning on the tap, and then sat just a few metres away as a dozen enormous bulls sucked up the water and poured it down their throats. One of my photos was shortlisted for the Wildlife Photographer of the Year competition.

What's been the most time you've had to invest in photographing something?

I've had several failed attempts to see wild dogs. The first time, again at Kipalo Hills in Kenya, the dogs had been regular visitors to the camp for days before I arrived, but while I was there they vanished. We searched for them for four days with no luck. Then, a few months later in Botswana, we had several reports of dogs being seen but each time we raced to the location they had gone. I did finally manage to see them for the first time in January – twice!



On a photo safari on the Chobe River

Have you ever experienced any particularly hairy moments?

One evening in Botswana, coming back late from a game drive, we stopped to let a herd of elephants cross the road in front of us. One huge bull decided he didn't like us, and started huffing and flapping his ears. You know it's tense when you see the driver put his hand on the car key, poised for a quick getaway. Fortunately after expressing his displeasure for a bit, the elephant continued on his way.

What's the worst level of discomfort you've had to endure in the name of wildlife photography?

In Uganda I went gorilla trekking during rainy season. And when it rains in Uganda, it's torrential. For four hours we got drenched while we slogged and slip-slided up and down muddy jungle trails-turned-rivers in search of our gorilla family. All my gear was double-wrapped in plastic bags, and I was convinced I wasn't going to be able to take any photos at all. But, just as we found the gorillas, the rain finally eased and I was able to get the camera out.

What one piece of kit would you never be without on a shoot?

For wildlife photography, it would have to be my Canon RF 100–500mm lens. I love the versatility of being able to get both tight close-ups and wider environmental shots with one lens. That said, I do dream of one day being able to afford (and carry!) a 600mm f/4 prime.

What's your one piece of advice to budding wildlife photographers?

It's something I'm guilty of not doing enough when I'm home, but get out there and practise. Wildlife is everywhere – even in London we have pigeons, urban foxes, squirrels, parakeets, deer, ducks and swans, even pelicans. If you know your subject and shoot it often, you can still capture distinctive images of common species and, if you practise a lot and master your camera, you won't mess up when the big moment happens.

Bella is a documentary maker, photographer and writer. See more at passportandpixels.com

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Antipodean Albatross © David Tipling

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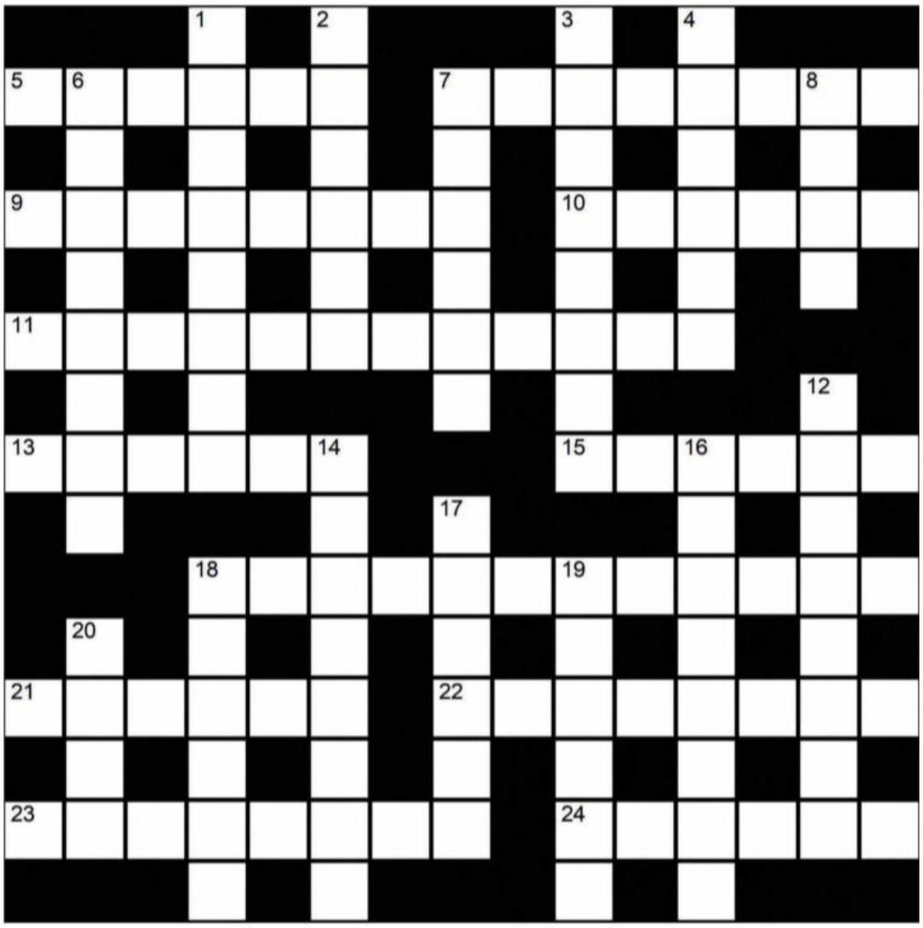
The crossword

ACROSS
5 Lemur that may be silky or crowned (6)
7 Insect in the family Sialidae, usually found near water (5,3)
9 Insect that emits noxious smells in self-defence (5,3)
10 Somerset cliff habitat noted for orchids and butterflies (6)
11 Large, long-legged grassland bird (5,7)
13 Part of a stag's headgear, perhaps (6)
15 Fish with the ability to breathe air (6)
18 Waterbird noted for its ornate breeding plumage (8,4)
21 ____ flycatcher, bird in the world's largest avian family (6)
22 Member of a Viper subfamily (8)
23 Plant of dry fields, also called ground apple (8)
24 Formed of flat projections, like an oak leaf (6)

DOWN
1 Precipitation (8)
2 Iconic African tree (6)
3 Large, predatory African stork (8)
4 Flowering plant that might be pyramidal, green-winged or bee (6)
6 ____ warbler, eastern counterpart of the melodious warbler (8)
7 Month in which most swifts return to Africa from the UK (6)
8 Flowering plant in the genus *Lilium* (4)
12 Large-billed tropical bird that may be blue-banded or crimson-rumped (8)
14 Female hen harrier, colloquially (8)
16 Christmas Island ____, crustaceans known for their mass migrations (3,5)
17 Insect juvenile forms, such as grubs (6)
18 ____ pipit, songbird of open country (6)
19 Antelope of eastern and southern Africa (6)
20 Bird in the starling family, known for its mimicry (4)

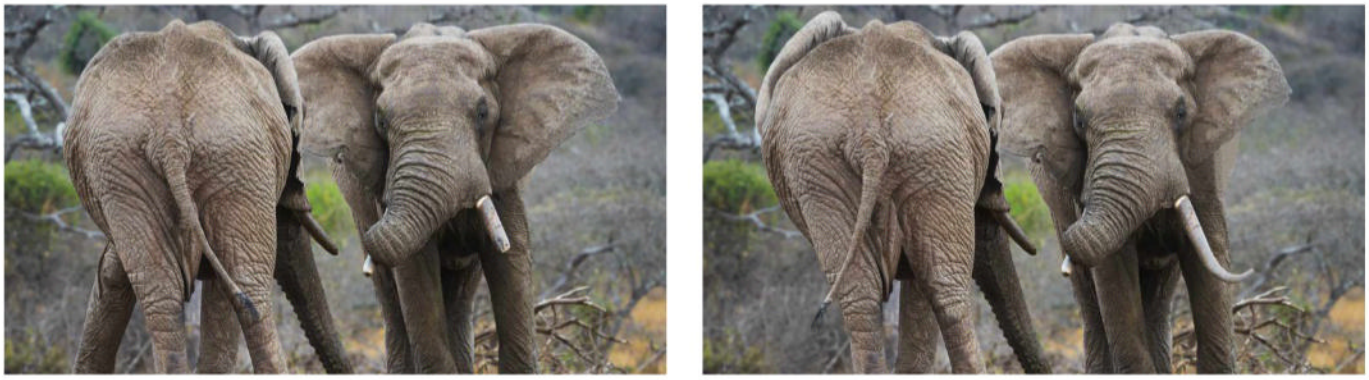


May crossword

Across: 1 Sawfly, 4 St Helena, 9 Aliens, 10 Erigeron, 11 Fleecy, 12 Celeriac, 13 Jay, 14 Scarab, 17 Babbler, 21 Auklet, 25 Egg, 26 Corn rose, 27 Winter, 28 Cat's-tail, 29 Ramose, 30 Accentor, 31 Stamen

Down: 1 Starfish, 2 White oak, 3 Land crab, 5 Turkey, 6 Eaglet, 7 Earwig, 8 Arnica, 12 Cabbage, 15 Bat, 16 Kea, 18 Ruminant, 19 Flatworm, 20 Sturgeon, 22 Acacia, 23 Arctic, 24 Triton, 25 Eskimo

SPOT THE DIFFERENCE



These African elephants were photographed in Chyulu Hills, Kenya. They are the world's largest land mammals – males reach, on average, up to 3m in height and weigh up to 6 tonnes. Can you spot all five differences between the two images? Turn to page 94 to find the answers.

CROSSWORD SET BY RICHARD SMYTH. ELEPHANTS: WIM VAN DEN HEEVER/NATUREPL.COM

Your LETTERS

Giraffes and visitors at Bristol Zoo Project

Zoo debate continues

Further to 'the great zoo debate' (April issue), I'm in full accord with your three correspondents (Letters, May and June issues): today's *good* zoos are invaluable repositories for the future, crucial treasuries and safeguards against extinction. Jersey Zoo and the much missed spirit behind it, Gerald Durrell, is an exemplary example. We must treasure and nurture good zoos, which are light years away from the dispiriting menagerie 'pens' of old, to help guard against the loss of wild species. Additionally, they confer on their first-time child visitors an irreplaceable opportunity to learn to treasure wildlife and animals.
Léna Godsall Bottriell, via email

The article discussing zoos said that we would never sanction the sacrifice of our own species to be displayed in such a way. This is an unfortunate misrepresentation of our colonial past. In fact, black African people such as Saartjie Baartman and Ota Benga, and indigenous tribes, including the Native American Sioux and Scandinavian Sami, were commonly displayed in zoos as 'savages' for white western audiences as late as the mid-20th century.
S Urquhart, via email

De-extinction discussion

I was absolutely dismayed to read the article on mammoth de-extinction in the May edition. Why on earth are 'boffins' wasting their time and efforts on something like this? We don't need extinct animals brought back to life – we can't look after the wildlife we have now. In addition, the article states that no one has successfully carried out IVF with an elephant, so I can only hope that this awful experiment fails.
Julia Larsson, via email

Grouse shooting

I'd like to comment on Mark Carwardine's sober article on grouse shooting in the May issue. I did my adult shooting hunting quail in southern California. For 30 years we lived overlooking a 140ha alluvial fan of mixed riparian and sage scrub habitat. I estimated the basin held over 300 quail – an astonishing density of ground-nesting game that would be the envy of any UK shoot manager. This peninsula of public land had no gamekeeping and was full of predators. There should have been few quail.

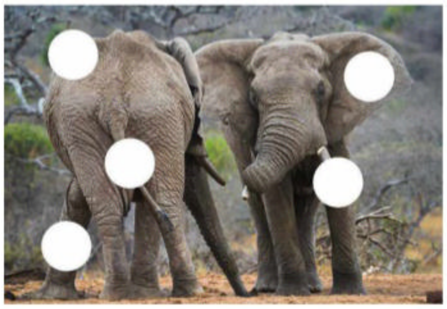
The California Department of Fish and Wildlife sells more than 150,000 upland hunting licences each year. The state limits bags to 10–15 birds per hunter per day. The hunting is difficult and bag limits are rare. By comparison, a small number of wealthy people with guns killing hundreds of grouse on a warm August day is the sporting equivalent of a penalty shootout with no goalie. Attitudes can change and models that do not involve the persecution of protected wildlife are there. It is appropriate for the government to curb the excess of the UK shooting industry. There is some catching up to do.
Hugh Bowles, Massachusetts, USA

Flying high

I am a keen amateur naturalist and thought you may be interested in publishing a poem that I wrote, *Golden Eagle.*

An ice-cold dawn with leaden sky.
A mighty eagle perched on high
Surveys the glen stretched out below,
from rocky heights still flecked with snow.
Weak sunlight strobes the granite rocks
and sparkles on the trout-filled lochs.
He leaves the craggy clifftop perch, glides
across the line of birch.
Then circles high and scans the glens
where black-faced sheep bleat in their pens.
Deer prints stud the sodden moor, where
the rutting red stags roar.
He searches cliffs for fallen rams, for
mountain hares and still-born lambs.
Sees the craig that saw his birth, beyond
the misty, distant firth.
Losing height on tilted wing, sees
movement in the purple ling.
Startled fox cubs near their earth bolt to
ground for all they're worth.
Two scurry to the depths below, a third
one scampers much too slow.
Now gliding fast above the heather, with
hunger reinforced endeavour.
Eagle talons full extended, fox cub
snatched and lifeless rendered.
Wing beats sound and thrash the air, as
fox cubs tremble in their lair.
He regains height, flies out of sight, strong
claws clutch the prey.

David Waterhouse, Sydney, Australia



Answers to Spot the Difference on page 93

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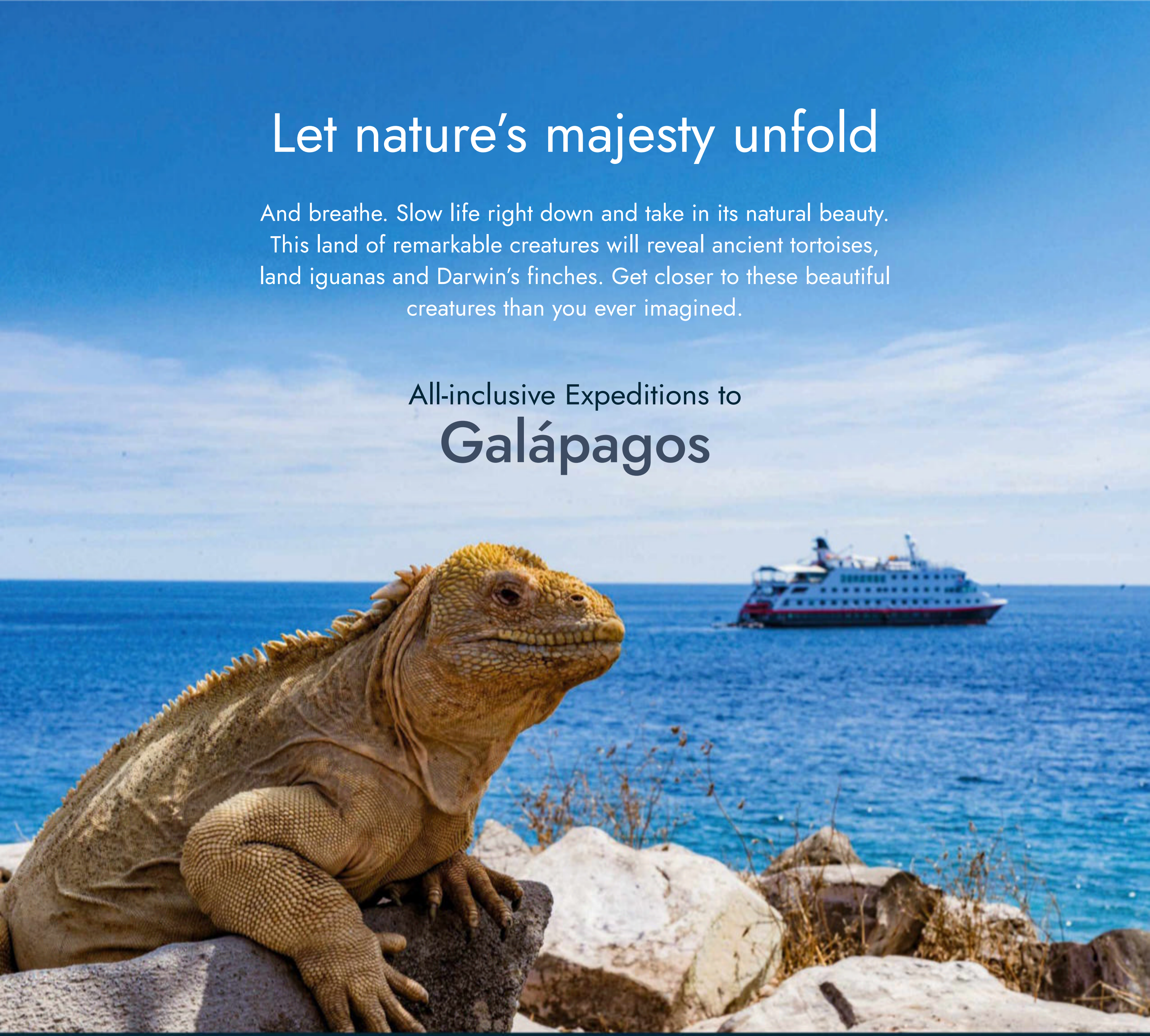

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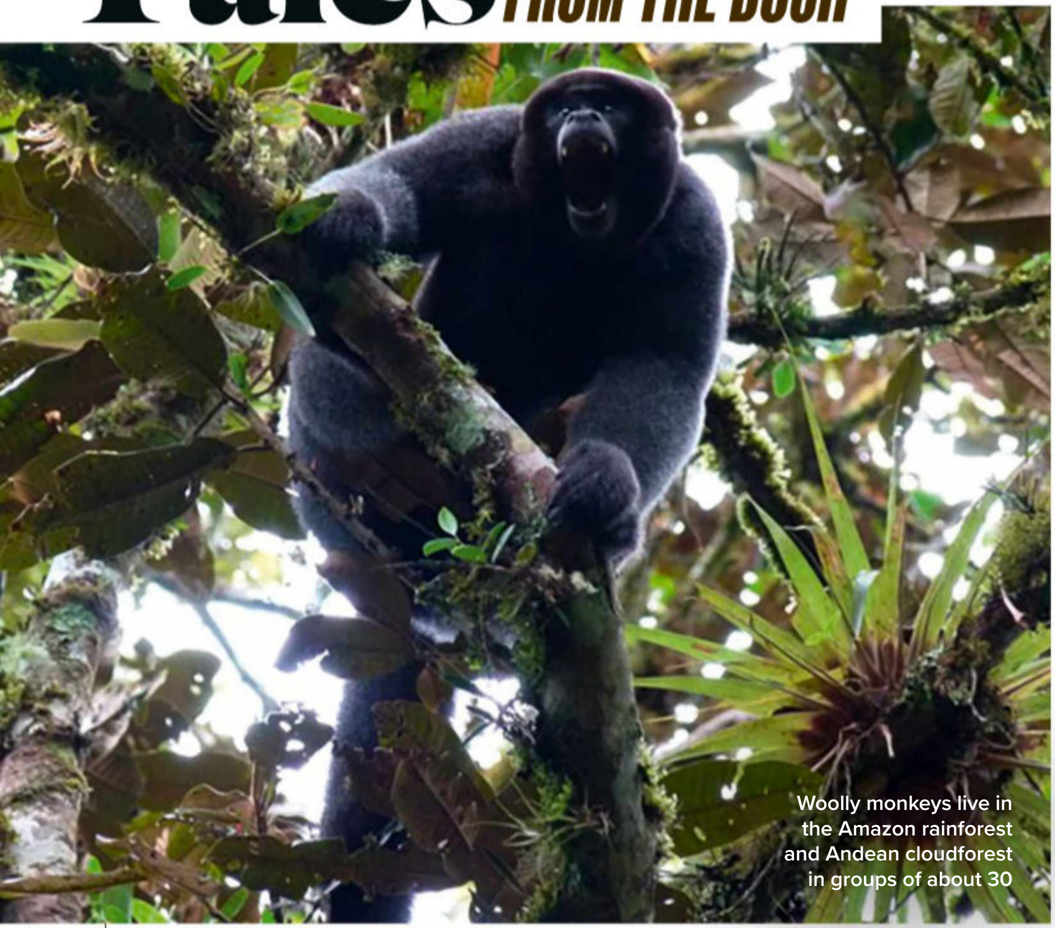

Woolly monkeys live in the Amazon rainforest and Andean cloudforest in groups of about 30

“In the blink of an eye, six of them hurtled towards my tree”

Woolly monkeys in the Colombian Andes

BY MANUEL FONSECA

“TWENTY METRES UP, THE CANOPY looks like a highway. Different shades of green, yellow and grey leaves fuse, creating the illusion of an endless rainforest.

I spent most of 2013 in the canopy of a cloudforest in Colombia, collecting insects and arachnids from inside bromeliads and mosses. I was studying how their availability influences the diet of the Colombian woolly monkey. Despite being one of the largest monkeys in the Americas, this species invests almost one-third of its diet budget foraging for insects. In contrast, large primates such as chimps invest about 4 per cent of their diet budget looking for this sort of protein.

During the course of my research, I sighted the monkeys from the ground every day, and they likewise saw me following them. In time, I learned to recognise them as individuals. I dreamed of encountering them up in the canopy, on their level. Would they approach me? Or would they run away? These are the sorts of questions that keep a primatologist up at night.

As my year in Colombia drew to a close, I still had not met a monkey among the branches. My dream fizzled away. One December morning, I set off on my final round of ascents, with my colleague Joha on the ground. I paused high in a laurel tree, admiring the infinite green highway for the last time. Suddenly, Joha started shouting. “Look!” she yelled. “The monkeys!”

And there they were, a collection of big-bellied silhouettes, swinging from branch to branch. Their muscular arms and legs were enough to make any bodybuilder jealous – even the females looked as if they spent their spare time lifting weights. Some were hanging from their tails, scratching themselves and scanning their surroundings.

Then, one of monkeys let out an alarm call. It must have spotted me. In the blink of an eye, six of them hurtled towards my tree. They surrounded me, grabbing and shaking the branches fiercely. My primatologist brain told me they were giving me a warning, and that I needed to be careful, but my body was flooded with delight.

Out of nowhere, a particularly large monkey landed on a thick branch just 5m away. It moved back and forth, frowning at me and baring sharp, yellow canines. It was an older male we had named Cafu, and his dark eyes were fixed on mine. I tried to back away, but my arms and legs went straight to voicemail. I was easy prey.

Then it hit me. I was surrounded only by males. They were creating a distraction so that the females and infants, who were further away, could pass through safely.

Male woolly monkeys are known to be closely related, sharing leadership duties and cooperatively caring for their young. Because of this, troops are not thought to have a dominant alpha male. But given what happened next, I now believe the opposite.

The males started to retreat, glaring back at me now and then. I tried to peer in the direction they were heading. Big mistake. Cafu grabbed an enormous branch and snapped it as if it were a toothpick. He threw it at me, missing my leg by a whisker.

My survival instinct kicked in at last, and I yelled at him. We locked eyes again. He was still showing me who was in charge; I was still at his mercy. Eventually, the other monkeys left and Cafu followed, jumping from tree to tree as if practising parkour. I glanced down at Joha, who looked terrified.

“Are you all right?” she demanded. “Come down!” It took me some time to respond. I was trying to process everything I’d just witnessed.

“Give me a minute,” I finally answered. “I still have to collect the samples.” Ⓦ

ABOUT THE AUTHOR

Manuel is a conservationist and wildlife journalist from Bogotá, Colombia. He is currently a Mongabay fellow interested in exploring narratives that amplify the voices of wildlife leaders.

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